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MARINE ENGINEERING AND SHIPPING AGE *announces the removal of its office from the Woolworth Building to 30 Church street, New York.*

Economy and Efficiency

THIS issue of MARINE ENGINEERING AND SHIPPING AGE is devoted to economy and efficiency not only because a great opportunity for savings in the cost of operating our ships actually exists but also because there is no better way of convincing Congress and the people of the United States that a permanent and constructive shipping policy should be adopted than by the elimination of every practice that may be pointed out as wasteful.

When Mr. H. E. Brelsford, chief of the technical section of the Shipping Board, made the statement, in his address to the Propeller Club on April 19, that "marine engineering was twenty-five years behind stationary practice" he presented a serious indictment against the shipping industry. Whether or not he is correct as to the number of years, unfortunately it is only too true that we do not get anywhere near the efficiency in the engine rooms of our ships that is commonly obtained in power plants ashore.

We all know this but what makes it so serious is the fact that, unlike a shore establishment, the cost of operating a ship per annum is far more than the total purchase price of the vessel at the present market values. Mr. J. B. Smull, president of the Emergency Fleet Corporation, and one of our most expert ship operators, in his testimony before the House Committee on Appropriations in 1921 said that it had cost his firm $48 per deadweight ton per year to operate cargo ships on very favorable trade routes, namely, from New York to Hull and from New York to Bristol.

On longer routes and with less efficient supervision this operating cost per annum might easily approach $60 a deadweight ton; in fact, this is approximately the figure recorded in Professor Chapman's "Relative Economy of Steam and Motor Vessels" which appeared in our January issue. But what is more striking is the fact that after removing all fixed charges, the shipowner who purchases a vessel at $30 a ton or less spends each year more than his original outlay for his ship on items, every one of which is directly influenced by economy and efficiency.

Such being the case, the natural question is why do not the shipowners modernize their methods and the equipment on their vessels? The answer to this, to a large extent, is the ultra-conservativeness of shipowners, which originated from the fact that reliability is far more important at sea than on shore.

We have no controversy with shipowners where reliability is concerned but there are many ways, and we say this with all due respect to shipowners who have been in the business for a long period of years, in which increased efficiency would also mean increased reliability. There are places where coordination would save large sums in one department even if they caused slight losses in another. The time has come when the successful shipowner must not be satisfied, as will be pointed out in an article appearing in the June issue of our magazine, with a ship that meets requirements; he must, in order to compete, be sure that his vessel *best* meets every condition in very department.

Trim the Insurance Costs

A DEFINITE percentage of the overhead may be reduced, if full care is given the details that enter into the cost of insurance. It is worth the effort. Bear in mind that the two fundamental considerations taken into account by underwriters are the record of the steamship line and the trade in which it is engaged. On this basis the insured may arrange his coverage advantageously and economically by watching the following arrangements: *Insure on an annual basis,* rather than by the trip. This will result in a saving of an average of twenty-five percent of the premium,

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dependent upon the length of the voyage and the trade the vessel is engaged in. *Watch the values;* that is, the amounts insured. Why pay for more insurance than you could collect in event of loss? Take out only so much as represents the actual values. *Keep repairs up.* Thus losses are minimized; and, for that reason, your rating is improved with the underwriters and you will always receive the most advantageous rate quotations. *Maintain a good record as respects losses.* This is the most important thing of all. Good records mean low insurance rates. To this end experienced officers and crews should be employed and they should be kept strictly on the job. Every care should be exercised in loading and stowage. Do not allow trickery in log entries; underwriters have a way of discovering the falseness in ascribing the consequences of carelessness to "heavy weather." *Cheap insurance is false economy.* The claim-dodging underwriter and the insurer of questionable solvency are the worst possible dependencies.

What Else Can Be Done?

THE announcement of the administration plan to develop our merchant marine even if it becomes necessary for the Government to directly operate the ships ought to make it plain to the whole country and the world at large that the time for action has arrived. Ever since the armistice was signed, over five years ago, we have indulged in endless conferences which we must acknowledge have resulted in no settled policy that could command the enduring support of the nation.

We appear to be as much at sea as we were at the start. Our most prominent shipping men, while opposed to the principle of Government operation, can suggest no practical alternative that would be reasonably sure of attracting private capital into the shipping business. In the confusion of the moment, however, there is one fact that is clear and that is, that there can be no doubt but that Chairman Lasker himself regards Government ownership as "poison ivy in the garden of industry."

Therefore to understand the President's viewpoint it is necessary to emphasize the fact that we have been operating our Government owned vessels on a system that no sane business organization would consider for a moment. We refer to the "heads I win, tails you lose" MO4 agreement under which the Government not only pays all the expenses of operating the ships but commissions besides.

The President is not proposing to substitute Government for private ownership. There are practically no privately owned vessels in the foreign trade. What he is trying to do is to develop paying trade lines that would be attractive to private capital in place of the vicious system now in vogue which offers no inducement for the operators to purchase the vessels allocated to them.

With shipowners demanding a revision of the shipping laws and with Congress refusing to allow a constructive shipping bill to come to a vote, thereby throwing back on the Administration the responsibility for developing the merchant marine, what could a red blooded President do but let it be known that the American flag will not be allowed to disappear from the seas?

If American interests will purchase and operate vessels, well and good, they will receive the co-operation of the Shipping Board; but, if not, the President is prepared to direct that trade routes be developed at whatever monetary loss is necessary. Probably, however, the losses would be less than under the present system.

We say this because we know that the Shipping Board has developed an organization that can and will tune up the engineering and maintenance of these vessels to a high efficiency. The opportunity for instituting great economy *is there* and will continue to be until advantage is taken of the methods common in land practice.

We believe, therefore, that with shipowners taking a stand that it is not practical for private interests to purchase vessels until the shipping laws are revised, trade has increased and a permanent Government policy adopted, the President is justified in dressing up the ships and consolidating them into shipping lines that will be attractive to private capital. His chief aim is to establish an American merchant marine, under private ownership, if possible; but, if not, under Government ownership as long as necessary.

New Passenger Motor Liners

THE number of orders that have been placed recently for large motor passenger liners has caused something of a sensation in European shipping circles. The United Steamship Company of New Zealand started the ball rolling with their 20,000-ton, 600-foot liner which is now making good headway on the Clyde, and in which four 3,250 brake horsepower Sulzer engines will be installed. The Rotterdam Lloyd followed with a 15,000-ton liner, 550 foot in length, in which two 3,500 brake horsepower Sulzer type motors will be fitted, the hull and engines to be built in Holland.

The Swedish-American Line then contracted for a 17,000-ton liner to be built by Armstrong Whitworth on the Tyne and equipped with two 6,750 brake horsepower Burmeister & Wain engines of an entirely new type. This is undoubtedly the most remarkable development since the first motorship was built. The power will be developed in six cylinders, and the engines will be of the double-acting four-cycle design. Burmeister & Wain have always viewed the two-cycle type with disfavor and their solution of the problem of developing high powers is to retain the four-cycle principle, but to make the engines double-acting. Needless to say, they have carried out a vast amount of experimental work before feeling that they are on sufficiently safe ground to proceed with the manufacture of an engine of such extremely large size.

British owners have just placed two orders with Harland & Wolff, for 17,000-ton motor liners, in which a somewhat unusual machinery arrangement will be adopted. There will be four engines of the standard four-cycle single-acting design, but the ship will be a twin screw vessel with two engines geared to each shaft.

It will thus be seen that the motor driven liner is making great headway in England and the development has certainly been more rapid than most people anticipated.

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Lake Hull Insurance

IN anticipation of the new season on the Great Lakes there is much evidence of activity on the part of shipowners and operators, insurance men and industrialists generally. The capacity rush in steel and iron, together with the increased demand and hardening of prices for copper, mean a good business in the Lake ore-carrying trade. Grain should also move freely, and as the country's prosperity is near a peak-point there is likely to be a heavy movement in west-bound package freight. This insures activity for both hulls and cargoes, as a dull season entails the tying-up of vessels and a consequent heavy return-premium drain for lay-up returns. An increasing fleet is being developed for the carriage of automobiles from Detroit factories to the East. Lake hull underwriters have been in conference and have thoroughly discussed terms and conditions for the new season. It has been agreed to meet last year's basis, with the exception that no allowance be made for $2,500 deductible average. As was done in the last lake season, all freighters under any flag will be written at not less than 3¾ percent, on a value of not less than $70 per ton, and only under the American Lake Hull 1921 form. Any exceptions to these terms and conditions are to be referred to a special committee of five appointed for this purpose. It has also been agreed that where policies attach after August 1 and before October 1 an additional rate of ½ percent pro rata will be charged. For policies attaching after October 1 a pro rata of 1 percent additional is to be charged. The underwriters have also been studying the numerous constructive total losses on wooden hulls last fall, and it has been decided to support the efforts of the American Bureau of Shipping as regards an improvement in these conditions this spring; and to this end no policies are to be issued on wooden vessels without the insertion of a warranty requiring the vessel's classification by the Bureau. The insurance companies fail to discern any prospect of a reduction in repair costs and replacement charges, in view of the steady mounting of prices for steel and labor.

Is the Brooklyn Navy Yard Efficient?

IF as we believe the *raison d'être* of a navy yard is to expeditiously and efficiently repair and condition naval vessels, then it would appear from the observation of several of the hundreds of men whose business, or hopes of getting business, on the *America* has taken them to the Brooklyn Navy Yard that the first class battleship *Arkansas* is practically awaiting her turn while the major part of the attention of the official naval staff is being devoted to a merchant vessel.

There is no question in regard to the efficiency of the naval officers. They are fully competent to handle most any engineering job but if their attention must be divided between reconditioning an ocean liner and a battleship—the most intricate machine in the world—one or the other is bound to suffer.

We understand that no proportion of the fixed charges on the taxpayer's investment in navy yards is included in the estimates submitted on merchant repair work but what about the pay of the supervisory force in charge of such work? Is not the pay of naval officers provided for in an annual appropriation? If such is the case, and the navy yards intend to solicit outside work, is there any good reason why this appropriation should not be cut according to the proportion of such work obtained?

Due to the indifference and ultra pacific tendencies of the people in the interior, it is going to be a difficult matter to secure from Congress sufficient appropriations for the Navy or the merchant marine. Why make it still harder by giving some of our "hard boiled" Solons an opportunity to point out that a navy yard engaged in extensive reconditioning work ought to be able to pay its own way just the same as private shipyards.

More than this the employment of a large number of men in a navy yard on merchant work is apt to cause suspicion that there is a vote-getting object in view. The Navy Department will find out, if it continues to compete with private yards for reconditioning jobs, that Congress will surely estimate the value of such work in determining future appropriations.

A Change of Attitude

THAT the conservative attitude of American shipowners toward the adoption of the motorship is changing to one of approval and even of enthusiastic support is becoming apparent as the results obtained with this type of propulsion abroad and the attitude of foreign shipowners are becoming better known to American engineers by personal investigation and observation. This change of viewpoint is shown by the recent statements of Mr. A. S. Hebble, superintending engineer of the Southern Pacific Lines, upon his return from an extended visit to the largest manufacturers of Diesel engines in Great Britain and Europe. Not only was Mr. Hebble very favorably impressed with the progress that has been made in the development of Diesel engines abroad but he has expressed the opinion that the motorship has a marked advantage over the steamship and that it offers great possibilities for the American shipowner to compete in world trade.

For the shipowner who is not favored with a supply of cheap fuel and has to buy fuel in the open market, Mr. Hebble believes that the motorship will prove the most economical, particularly in the transatlantic and transpacific trades and in service between the United States and South America. Regarding the adoption of this type of propulsion for passenger ships he heartily endorses the progressive policy of the shipowners abroad who have recently placed orders for five motor passenger liners varying from 15,000 to 20,000 each and declares that the Diesel engine is ideal for passenger liners up to 25,000 tons and of 18 knots' speed. Mr. Hebble has a word of caution, however, for those who have recently been impressed by the claims of Diesel engine manufacturers that the cheaper grades of crude oil or "boiler" oil can be used successfully as fuel in Diesel engines. While it is true that such fuel can be burned in most Diesel engines, the effect of this practice on the cylinder liners, pistons and valves, is more or less disastrous and the concensus of opinion abroad is apparently opposed to its use.

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American Marine Standards Committee Meets

Method of Organization Adopted and Administrative Committees Appointed—Technical Supervisory and Sub-Committees Will Be Established to Recommend Standards for Hull, Engineering and Operating Details

IN order that the marine industries in the United States may benefit by the establishment of recognized standards for hull, engineering and operating details and thereby reduce the cost of ship construction and operation, so that competition with foreign shipping may be on more equal terms, the general committee on standardization, recently formed by the American Marine Association has adopted a plan of organization which will enable it to establish standards in the marine field comparable with the work of similar committees in other lines of engineering effort, both here and abroad, but entirely independent of them.

To Be Known as American Marine Standards Committee

At the third meeting of the general committee, which was held in New York on April 17 with Captain R. D. Gatewood, U. S. N., as acting chairman, it was resolved that the standardization and simplified practice project in the marine field be carried on under the name of the "American Marine Standards Committee."

The purpose of the American Marine Standards Committee is in line with the movement inaugurated by Secretary Hoover of the Department of Commerce for standardizing products and simplifying practice in the industries in order to eliminate waste and reduce costs. The extension of this work to the marine industries was proposed by Secretary Hoover at the annual Marine Exposition in New York last November and was taken up by the American Marine Association with the support of the Department of Commerce and the United States Shipping Board Emergency Fleet Corporation.

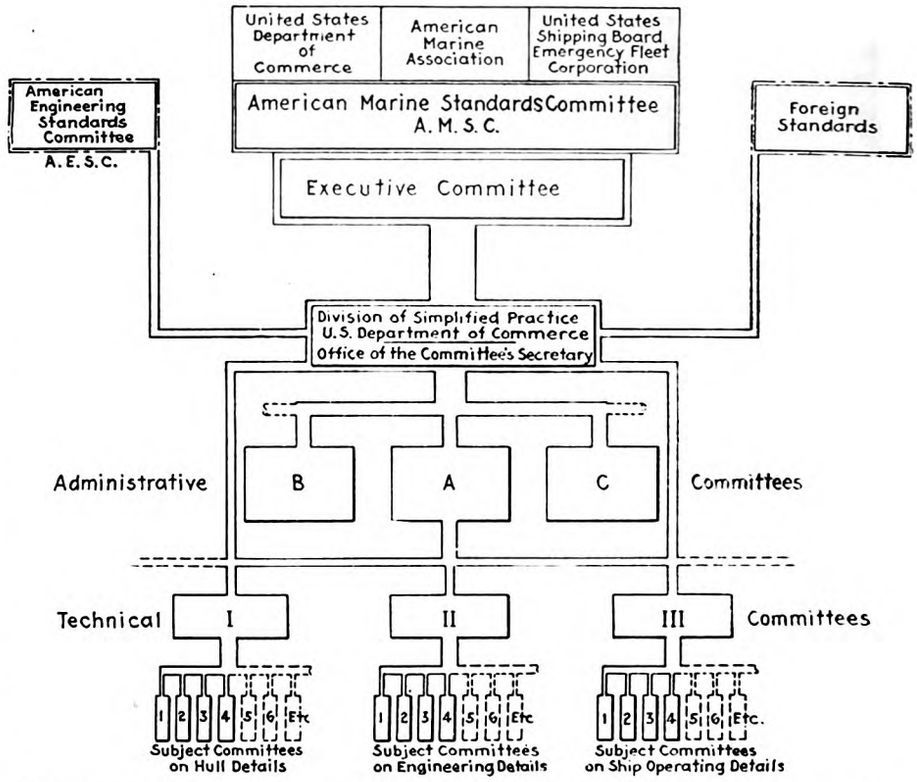

Fig. 1.—Chart Showing Organization of American Marine Standards Committee

In order to carry out the work expeditiously and economically, the committee has adopted the plan of organization shown in the accompanying chart (Fig. 1). The American Marine Standards Committee will act as the executive committee, all details and correspondence being carried out through the office of its secretary in the Division of Simplified Practice of the Department of Commerce in Washington.

The work of the organization will be administered primarily by three committees as follows:

A—Organization, membership and finance.
B—Constitution and rules.
C—Publicity and relations.

The policies of these committees will be carried out by the secretary.

Administrative Committees Appointed

The following were appointed as members of the three administrative committees:

Committee A: Col. E. A. Simmons, president, American Marine Association, chairman; Capt. C. A. McAllister, vice president, American Bureau of Shipping, vice chairman; Charles F. Bailey, engineering director, Newport News Shipbuilding and Dry Dock Company; Hugo P. Frear, naval architect, Bethlehem Shipbuilding Corporation, Ltd., and E. H. Rigg, naval architect, New York Shipbuilding Corporation.

Committee B: William F. Gibbs, president, Gibbs Bros., chairman; E. H. Rigg, naval architect, New York Shipbuilding Corporation, vice chairman; Capt. John F. Milliken, secretary, Neptune Association; John W. Gray, Newport News Shipbuilding and Dry Dock Company, and Capt. C. A. McAllister, vice president, American Bureau of Shipping.

Committee C: Capt. C. A. McAllister, vice president, American Bureau of Shipping, chairman; Capt. R. D. Gatewood, U. S. N., United States Shipping Board Emergency Fleet Corporation, vice chairman; Col. E. A. Simmons, president, American Marine Association; John W. Gray, Newport News Shipbuilding and Dry Dock Company, and Capt. John F. Milliken, secretary, Neptune Association.

Technical Supervisory Committees

Through the committee on organization known as Committee A, three technical supervisory committees will be created as follows:

I—Committee on Hull Details.
II—Committee on Engineering Details.
III—Committee on Ship Operating Details and Consumable Supplies.

Through each of these technical supervisory committees there will be formed a large number of subject committees to which will be assigned the task of studying and formulating a standard for such specific items as will from time to time be designated by the executive committee, of which Mr. A. V. Bouillon has been appointed secretary.

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The Government's Shipping Policy

American Merchant Marine Will Be Established and Maintained Even if the Government Is Forced to Operate the Ships

By Harold F. Lane*

WHETHER government operation of the ships, left on the government's hands as a heritage of the war, is to be the only policy which the administration at Washington will consider available as a result of the failure of the subsidy bill is still an open question. Both the President and the members of the Shipping Board are opposed to the adoption of such a policy, and have let it be known that such a course would be adopted only as a last resort. Further efforts are to be made to sell the ships but, if buyers do not come forward on terms regarded as acceptable by the board, it has been decided to go to direct government operation of the vessels for an indefinite period. Apparently neither the administration nor the board is very optimistic any longer as to the prospects of selling the ships on reasonable terms, and it has been decided that sales will not be made at "unjustifiable sacrifices." Chairman Lasker has also indicated that unless the shipowners and operators have been "bluffing" heretofore on the subject of the terms on which they would buy, he regards the chances of obtaining acceptable terms as rather slim. He also said he did not believe that they had been bluffing.

Extended Conference Held at White House

An extended conference on the subject was held by the President with the full membership of the Shipping Board at the White House on April 14, and a thorough discussion of the problems to be solved was had in the light of a report from the board's committee, which was making a special study of the questions of policy involved. After the conference it was announced in a White House statement that the board had unanimously agreed, with the President's concurrence, *"that the chief end to be sought is the establishment and maintenance of an American merchant marine,"* and that "with the failure of the subsidy act the board is confronted with the possession of a vast number of ships and the heavy losses under the existing plan of allocated operations under managing agents."

To Consolidate Foreign Trade Lines

In compliance with the shipping act, the statement continued, the board will proceed at once to the consolidation of foreign trade lines, and then offer the sale of these lines and ships under the authorization of the law, conditional on a suitable guaranty of maintained service. "If such sales can not be made without unjustifiable sacrifice of the ships, then the government will proceed to direct government operation aggressively pursued. In short, there is unanimous agreement that the existing law contemplates and authorizes an adequate and maintained American merchant marine, and such a course will be followed as will fully guarantee it and contemplate its larger development." It is hoped that following the consolidation of the lines it will be possible to enter upon a sales campaign within 60 days.

Will Ask Congress to Authorize New Construction

If continued government operation becomes inevitable, Congress will be asked at the next session to make an appropriation not only to meet the annual deficit from operations but also to undertake a considerable expenditure for new ship construction to balance the present fleet. President Harding is proceeding on the assumption that in this way the responsibility for the future policy will be placed squarely upon Congress. If it is unwilling to appropriate enough to balance the fleet and maintain it there will be nothing else to do than to get out from under as speedily as possible. The losses of the Shipping Board from fleet operations have been reduced to about $50,000,000 a year, as compared with about $150,000,000 when the present board took charge. The number of managing agents was reduced, and their form of contract has been considerably revised, but, if it is found impossible to sell the ships, there will be a discontinuance of the managing agency agreements, which the board believes will still further reduce the losses.

During the month, while the President and Chairman Lasker were in Florida, the policy committee of the board, headed by Commissioner Meyer Lissner, has been giving close study to the problem of what should be done in connection with the government-owned ships, and conferences were held by the committee with representatives of the shipowners, the shipbuilding industry and the managing operators. The results of the conferences were later submitted to the entire board, and its views of the various perplexing problems that have arisen were laid before the President at the conference held within a week after his return to Washington from the South.

Position of Steamship Owners

The position of the American Steamship Owners' Association was set forth in a letter from A. G. Smith, president, to Commissioner Lissner on March 26, after a conference with the committee of the association. The letter stated that the association regards it as fundamental that the Shipping Board and Emergency Fleet Corporation should retire from the business of operating ships and place the operation of the essential routes in the hands of private owners. The Shipping Board should immediately scrap such vessels as are inferior in design, equipment or condition, the association said, and it should offer its remaining vessels for sale to American citizens without restrictions and without discrimination between buyers.

Ship Operators' View

A committee representing the United States Ship Operators' Association also conferred with the Shipping Board committee on March 28 to present the views of the managing agents who are operating government-owned vessels under what is known as the M O 4 agreement. They stated that those operating Shipping Board vessels are ambitious to become shipowners and look forward to the time when circumstances will permit them to purchase, but that they must face the economic fact that capital will not invest in ship securities until the profits are equal to and as reasonably sure as those in other lines of business. This committee was given to understand by the members of the Shipping Board that it was the intention of the board to discontinue the M O 4 system, apparently because there

*Washington correspondent.

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is little stimulus under it for ambition to become a shipowner.

Another conference was held on March 29 with representatives of the shipbuilding industry. The shipbuilders expressed the opinion that only by giving preferential treatment to American shipping could it be made sufficiently attractive to warrant the expenditure of the considerable sum of money that would be required for the purchase and operation for a number of years of any large number of government ships. Homer L. Ferguson, president of the Newport News Shipbuilding and Dry Dock Company, advocated such matters as the bringing of the Philippine trade of the United States under the coastwise laws, reduced railroad rates on through shipments for export and import when carried on American flag ships and the abrogation of those portions of commercial treaties with foreign nations that prevent preferential treatment in tonnage taxes to American flag ships and preferential customs duties on imports in American vessels.

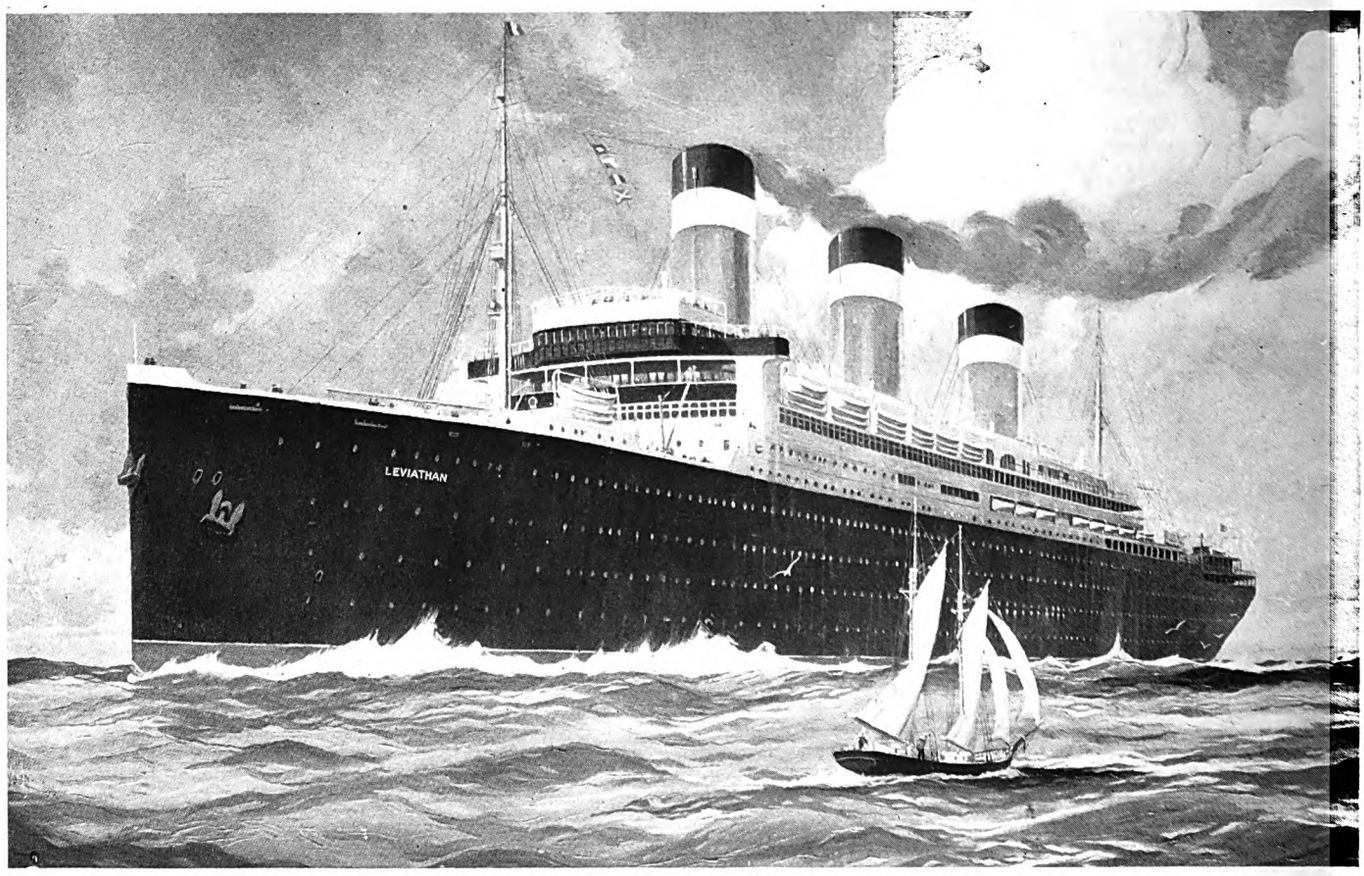
The Shipping Board had also issued a statement intended to make it clear that there is no prospect of Shipping Board ships being sold at less than world market prices for unrestricted service under any plan that the board has had under consideration. Studies had been made for offering ships on lines at a considerable reduction from world market prices in those cases where the purchasers will guarantee to maintain the services in foreign trade for a term of years, but it was stated that there was no intention of making reductions where there is no guarantee of the maintenance of the service to foreign ports and no reason at all why reductions should be made for the sale of vessels to be used in the protected coastwise trade, where foreign flag ships may not compete. The statement added that there was, therefore, no reason why shipowners should hesitate to buy ships at the present time for unrestricted or coastwise or intercoastal operation because of any expectation that ships for such service would be sold at greatly reduced prices later on.

Leviathan Now Largest Ship in the World

THE *Leviathan* will start on her maiden voyage to Southampton and Cherbourg as a passenger ship under the American flag on July 4. This sailing of the largest, most famous and most luxurious ship in the world on Independence Day is highly significant of America's determination, in spite of all handicaps, to develop a transatlantic service that will offer even better inducements in the way of luxury, convenience and comfort than can be obtained on any of the ships of our maritime rivals.

The *Leviathan* was the greatest and most famous of all transports during the war. She has taken nearly 13,000 troops at one sailing, which is by far the largest number ever carried by any ship. American workmen, engineers and architects have now made her the greatest of all passenger ships. Her gross tonnage is now 59,956 and she will carry 4,200 passengers in addition to a crew of 1,100.

The *Leviathan* is 950 feet 7 inches overall and 100 feet in breadth. The height from the bottom of her keel to the top of her smokestack is 184 feet. Steam will be generated in 46 express type watertube boilers which have been fitted to burn oil fuel. The propelling machinery consists of direct connected Parsons reaction turbines driving quadruple screws. The normal shaft horsepower is 66,000 which will develop a speed of 23 knots. However, the power plant is capable of turning out 100,000 shaft horsepower.



The Leviathan, the Largest Ship in the World, As She Will Look When She Sails From New York on July 4 on Her Maiden Voyage to Cherbourg and Southampton. The Leviathan Will Be Operated By The United States Lines and Will Be Commanded by Captain Herbert Hartley. She is 950 Feet Long with a Beam of 100 Feet and a Gross Tonnage of 59,956.65.

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Situation Demands Reduction in Cost of Operation

Fuel Conservation Committee Setting Pace in Reducing Fuel Costs— Cooperation of All Departments Must Be Rigorously Carried Out

By "Old Scotch"

THERE are always two ways of doing things—hence for Americans to operate ships successfully, they must either get more revenue than they are now receiving, or else reduce the costs of operation which are now being paid. Perhaps a combination of the two will best fill the bill. From the present outlook, however, the chances of getting more revenue are not very propitious, if we may judge by the action of the senatorial heads of blocs, or blockheads, just as you may choose to consider them. As world conditions improve, as they eventually must, freight rates will undoubtedly pick up, but that is in the future, and money expected several months or years from now, does not pay crews nor keep the fires burning under the boilers right at this time.

There is one absolutely sure thing that we have to face, and that is that our shipowners must have their expenses of operation cut down at once, or there are going to be many more Yankee ships tied up to the wharves than there are at present. Tied-up ships mean idle crews, so it behooves everyone connected with ship operation to look at this situation seriously and begin economizing in the expenditures with which he is connected. The head of a household, when faced with domestic problems requiring retrenchment, is prone to begin cutting down his wife's allowance, while he goes merrily on smoking good cigars and patronizing bootleggers.

> **We are up against a man-size problem, and we must not lie down because forsooth Congress did not pass the legislation we so ardently desired. If we make an earnest and desperate effort to eradicate our own shortcomings in ship operation, there is much more likelihood of our obtaining help from our Government, when it is conclusively demonstrated that we have used every effort to help ourselves.**

Greatest Savings Possible in Engine Department

So each department of ship operation thinks that the other fellow should retrench and cut down his expenses, supinely copying the ostrich in that respect. The engine department controlling expenditures for fuel, lubricating oils, machinery repairs and engineer's supplies naturally is the greatest spender of money, and he who spends most is usually the one who should make the greatest savings.

The writer might modestly inject in the discussion at this point, that he is no new convert to economy in engine operation, as most of our readers will recall that he has been advocating reforms of this kind for over ten years in the columns of Marine Engineering and Shipping Age. He must also admit that during the past five or six years of profligacy in the operation of American ships, his advice has been little heeded, as the waste which has taken place during this period of high returns from ocean freights has been most appalling. Within the past year the reformation has begun in earnest, and there are already indications of much better conditions.

Fuel Conservation Committee

The United States Shipping Board, the largest single operator of ships in the world, has set the pace. This has been brought about largely through the influence of Vice-President Joseph E. Sheedy in charge of ship operations, who himself has been a sea-going engineer and knows intimately the problems confronting the men on the ships. The organization of the Fuel Conservation Committee to take up the task of reducing the cost of oil and coal, the largest single expenditure connected with the ships, is directly due to Mr. Sheedy and this committee has shown results which amply warrant the prediction that its efforts will be crowned with success.

This effort was made none too soon, as since the committee began to function last August the contract costs of both fuel oil and coal have advanced nearly fifty percent. Through the hearty co-operation of the Bureau of Engineering of the Navy the oil-burning school at the League Island Navy Yard, Philadelphia, has been made available for all American marine engineers, who may be sent there by the Fuel Conservation Committee. Its course of instruction is not confined to engineers on government owned ships, by any means, as all superintending and operating engineers who are American citizens are welcomed at this school of instruction.

Tangible evidences of the good which this school is accomplishing are getting more and more frequent. Fuel reductions of from ten to even thirty barrels of fuel oil per day are reported by the graduates of the school, and they give direct credit to the instruction which they received at League Island. The old idea that any one could burn oil efficiently under marine boilers is rapidly disappearing. The right methods are the only ones to use, and these can be obtained only from instructions by experts, who have made an intensive study of every phase of the art.

Such terms and abbreviations as viscosity, CO_2, Beaumé and B. T. U's now mean something finite in the minds of sea-going engineers who have received instructions laid down at the school, where heretofore they were largely dismissed from the thoughts of men actually in charge of firerooms as merely "highbrow stuff," which needed no attention from the "practical" man.

A knowledge of the proper "refractories" used for furnace linings, is productive of great economies both in amount of fuel used, and in voyage repairs. Heretofore marine engineers have been at the mercy of well meaning but ignorant brick-laying repair men, in selecting and applying proper refractory materials for the "ship's stomach." Both theoretical and practical instruction are given at the school to all students, and a few hours of close application under the direction of skilled instructors will make the ordinary marine engineer fully cognizant of the latest and best practices along that line.

Accurate Performance Records Calculated

In addition to the school, the technical staff working with the committee is busily engaged in collecting and analyzing data obtained from the logs of the operating vessels. The present fleet is divided into several distinct classes and types, such as the 535's, the 8,800-ton vessels, the Hog Island ships,

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etc., which are grouped together and lend themselves quite readily to the tabulation of comparative performances. Standard fuel consumptions are assumed, which are readily obtainable on efficiently operated vessels, and comparisons are made on the basis of knots run per ton of fuel expended, the draft of water during each particular run being given due consideration.

On the best vessels of a type a number are showing efficiency ratings of over 100 percent, on the assumed basis. It is quite easy to pick out the "poor actors" when the type data is recorded on one sheet for all of the vessels coming under the particular category. There have been several vessels which showed as low as 65 percent efficiency, by this method of comparison, which otherwise would have been undetected except in the bills for fuel, which probably would have been accounted for by more or less general denomination of "bad actors" due to war construction.

Personal Instructions Given

In most instances of this kind special inspections are made of the personnel and machinery, and the principal faults quickly located. If bad performances have been due to inefficient personnel it is surprising how quickly results have been improved under instructions given by the special inspectors attached to the technical staff of the committee. Copies of all these relative performance sheets are placed in the hands of the chief engineers of all vessels in the list. This at once appeals to their pride of performance and due to the inherent human characteristic of rivalry, usually results in better performances in future runs. The whole tendency is towards improvement all along the line. If the best results are obtained by chief engineers who have attended the school of instruction, the less fortunate operating engineers immediately express a desire to have the benefits of the school given to them.

Further Leaks to Be Stopped

The committee realizes that its work has only just begun and is determined to investigate and make improvements in all the minor details of operation where losses of fuel can be checked. The proper setting of propeller pitches for the various types of vessels is being given intensive thought, so that this important matter will no longer be governed by the personal whims of would-be experts, as has been too often the case in the past.

Poorly constructed and inefficiently operated condensing apparatus is a fertile source of fuel loss, and will be taken up by the committee experts, as soon as conditions will permit. Inefficient and wasteful port operation of auxiliaries cause great losses of fuel, ofttimes on vessels which are very efficiently operated while underway at sea. Methods for minimizing these losses are now being studied, and remedial measures will be applied as rapidly as possible.

The committee has already prepared, and had posted in the engine rooms of all sea-going vessels, rules for the receiving and accounting for all quantities of fuel. This, together with greater care in the recording of expenditures at sea, will greatly aid the work of economizing, by providing more accurate data on which the results are recorded.

All Departments Must Cooperate

Summing up, the economizing of fuel is well started and good results may safely be predicted. But economies must be started and rigorously carried out in every other expenditure connected with ship operation. The deck department and the steward's department must lend a hand, and squeeze out every cent of unnecessary expenditure in every detail, no matter how comparatively insignificant they may appear. Ship repairs on American ships have been one of the greatest sources of waste, and, although considerable reductions have been made, there yet remain vast improvements to be accomplished. This subject will be given more intensive consideration by an expert in another article in a later issue.

America Should Lead in New Methods and Inventions

In addition to all these efforts towards economy, we must not forget that Americans have a habit of leading in new methods and inventions when they really put their brains to work in any great industry. Mark how easily the lead has been taken in the automotive industry when American capital and methods went at that game in an intensive way. In the ballad of the *Mary Gloster,* the dying shipowner probably best expressed the possibilities along that line of effort in the following verse:

I knew—*I* knew what was coming, when we bid on the *Byfleet's* keel—
They piddled and piffled with iron. I'd given my orders for steel!
Steel and the first expansions.
It paid, I tell you, it paid,
When we came with our nine knot freighters and collared the long-run trade!
And they asked me how I did it, and I gave 'em the Scripture text,
You keep your light so shining
A little in front o' the next!
They copied all they could follow, but they couldn't copy my mind,
And I left 'em sweating and stealing a year and a half behind.

In the wild rush of creating our merchant marine fleet, all ideas of improvements over existing conditions were thrown ruthlessly aside in order to get out the ships in time for war demands. Now with plenty of time to devise new apparatus and methods we should be able to re-condition many of our existing ships and make them up to date in motive power and auxiliaries, so that as a whole they can be "a little in front o' the next," the "next" in this instance being the average ships of our competitors.

Diesel-electric Drive Promising

As new construction is demanded our best talents should be devoted to designing the most efficient ships afloat. While the Diesel engine is decidedly a foreign "step" ahead of us, and we have not kept up with their pace at all, the electric drive is distinctly American. The combination of Diesel generator and electric drive appears to be the most promising field of advancement in order to get ahead of the other fellow, and keep ahead of him. American design and methods of manufacture, if applied to this new field of propulsive power, ought to enable us to step out ahead of all competitors so far as fuel economy and operating efficiency are concerned.

Improve Cargo Handling Methods

American methods and ingenuity in handling cargoes is another direction wherein advancement can be made. The present cargo handling costs in American ports are far too excessive, while the methods used for handling cargoes on our own Great Lakes are not altogether applicable to cargoes handled along our seacoasts, there is still much that can be learned and adopted from our fresh water brethren, both in apparatus and systems employed.

We must not depend too largely on the mechanical means employed in shipping, as after all is said and done our success must be gained by the intelligent use of modern means. To that end a great deal of study and improvement must be made by the personnel in order to bring about the necessary advanced efficiency to enable us to hold our own in the fierce competition we must meet on the seas.

(*Continued on page* 262)

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Economy in Steamship Operation and Management

Aggregate of Losses Often Considered Trivial by Americans Is Frequently Sufficient to Maintain Our Foreign Rivals

By Robert F. Hand*

THE events which led to the defeat of the subsidy legislation clearly demonstrated that there can be no government relief for the shipping industry of this country until public opinion has been educated to the vital importance of a merchant marine. There is every indication that this will be a long and tedious process, while the recent decision of the Treasury Department that repairs made in foreign ports are subject to a 50 percent ad valorem duty renders the immediate situation more difficult and leaves little hope in the minds of men responsible for the operation of American ships.

However, our steamship owners are accustomed to discouragement and used to facing handicaps. They are already planning ways and means of meeting the situation and operating their vessels against the deadly competition of subsidized foreign tonnage.

It is evident that a solution can only be worked out through extraordinary efforts to increase the efficiency of management and operation with a resulting economy that will reduce our operating costs to a level close to that enjoyed by our foreign competitors. This is an ambitious program, but it has been said that the average American throws away enough to keep a foreigner, and there is no doubt that we have in the past been guilty of great extravagance in the operation of ships.

The necessities of our present situation will demand a much more thorough investigation and study of combustion problems than has been accomplished in the past. Fuel oil combustion efficiency is seldom checked by scientific means, and there is no doubt that the present methods of oil burning, particularly in Scotch boilers, can be largely improved for economy. Steamship operators may find it advantageous to encourage wider interest in this important problem and to enlist the assistance of Government laboratories and test plants in experiments leading to greater economy in the burning of fuel oil.

Contact With Ships' Engineers Advised

This is particularly true in the Engineering Department. We have not given the operation of machinery the study and thought necessary to obtain the lowest possible operating costs, and we have also failed to establish close touch with our ships' engineers and encourage them to keep abreast of the latest and best engineering practice. In fact, we have been inclined to consider losses through faulty machinery operation too trivial for consideration, but we cannot neglect them henceforth, and it may be found that they represent a considerable part of the fuel bill.

Any economy in engineering must depend primarily upon close and intelligent supervision and this must be founded upon an adequate and well planned set of performance records in the central office, as it is only by this means that useful comparisons can be made and faulty operation readily detected. These records must be supported by careful observations and intelligent reports from the ships' personnel, and the American engineer is well qualified to handle this important phase of his duty if he is properly informed and the shore end of the work is well taken care of in competent hands.

*Assistant Manager, Marine Department, Standard Oil Company of New Jersey.

Systematic Records Will Help

Many sources of economy will be uncovered by a close study of the engineering records of ships. A careful analysis of indicator cards and the temperatures and pressures carried throughout the plant, together with a careful check-up on the condition of auxiliary machinery will generally lead to considerable economy. It will also be found that a material saving will result from a special campaign against leaks with a thorough study of the packing used throughout the plant, with a view of assuring the best possible selection of material in each case.

Large saving can be accomplished by organizing repair work on a periodical basis to fall concurrently with necessary boiler cleaning. This method offers the advantage of centralizing the work in those ports where the best supervision is obtained, and saves money by enabling contracts to be placed under competitive bids after specifications have been carefully prepared. A well worked out schedule for periodical repairs and boiler cleaning will, moreover, permit a thorough inspection system to be established, which will in itself promote economy.

Successful Competition Requires Quick Turn-Around

Both shore and ship organizations of American companies will have to be trained to appreciate the vital importance of rapid loading, discharging and dispatch if we are to compete successfully with foreign companies who are far ahead of us in turning vessels around in port. We have been inclined to attribute foreign superiority in this respect entirely to better dock facilities, but it will be found that the vital factors in quick turn-around are organization, co-operation and energy.

Purchase and Care of Stores

Engine and deck stores offer a very profitable field for special efforts to attain economy, because American ships have been in the past extremely wasteful and unbusinesslike in their methods of handling stores. Great care should be used by all concerned with the ordering of material to assure that requisitions are reduced to the minimum requirements of necessity, and that specifications are carefully written in all cases so that the ship's storerooms are not cluttered with material for which there is no use, and which, besides representing a useless initial expense, involves a steady loss through rapid depreciation aboard ship.

Little attention has been paid in the past to the proper stowage and care of stores aboard ship. Mates and engineers who are responsible for storerooms should not only see that their material is properly stowed with every advantage for preservation, but should also keep a very careful check and

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inventory of stores on hand, for if this is not done waste and extravagance are bound to result.

When a large or even considerable fleet is operated, great economy will result from establishing a central warehouse from which all vessels are supplied. This not only offers the benefits of quantity purchasing and careful inspection of material, but presents the added advantage of permitting a close scrutiny of requisitions and the best possible assurance that excessive or uneconomical orders are not filled.

Steamship operators will find it economical to adopt a combined Specification and Stock Book which is a standardization of all stores and equipment required for the operation of the fleet. This book should indicate to all concerned what items are on the standard list of each department, and also furnish brief specifications for each item, sufficient to identify it and to assure that the article purchased and supplied is the identical article required.

Items for each department may be arranged in two general groups designated "Consumable" and "Equipment," the distinction being governed by the value of the individual item and the frequency with which it requires replacement. For convenient reference and record keeping the contents of each of the above groups should be subdivided according to their general character or use into a number of classes, briefly defined and listed under a classification index.

It is believed that this system of classifying and ordering stores will result in marked economy, and after it has been in operation for a considerable period in this form, the book may be made the basis of a ship's allowance system which will effect further economy and efficiency in storing vessels.

A happy ship is always an efficient ship and a crew is never content if the men are not well fed. Good feeding does not necessarily mean extravagant operation in the Steward's Department however. It is entirely possible to improve the quality of meals aboard ship and at the same time make large reductions in feeding costs. This is proven by the experience of our company, which reduced its feeding costs in half during the period from January, 1921, to the present time, and accomplished during the same period a marked improvement in the quality and service of food.

This gain in efficiency followed an intensive economy campaign in the hands of an energetic Supply Section head. The purchase of provisions was carefully organized to provide quality products at minimum prices and a very careful check, based on a standard feeding provision list, was made of stores used aboard ship. In addition close contact was established between the office and the personnel of the Steward's Department afloat, so that incapable men were gradually eliminated from the organization and the personnel were instructed and encouraged to make the efforts that produced better results with a saving of more than 50 percent in cost.

It must be realized that whatever measures are adopted, their ultimate success will depend upon the loyalty and ability with which they are supported by the ships' officers. Therefore, the most important phase of the work that American steamship operators have before them is the special effort that must be made to keep in close touch with the seagoing personnel in order to impress upon them the necessity of economy and to enlist their loyal co-operation in attaining it.

Situation Demands Reduction in Cost of Operation

(*Continued from page* 260)

Schools of instruction in all branches of ship operation should be started along similar lines to those employed at the fuel burning school in Philadelphia. Our deck officers need advanced training in their functions of handling and stowing cargoes and in conducting ship's business in foreign ports.

Already the officials of Columbia University are looking into this matter in connection with their summer courses in industrial training of all sorts. With a very little encouragement on the part of shipowners, such courses could be started and made of incalculable benefit to the advancement of our merchant marine aspirations. Knowledge of all the details of any business is, after all, the controlling factor in any business competition.

The deck and engineer officers in our merchant marine of the future can no longer rest content with a superficial knowledge of the rudiments of their profession. It is the special knowledge of all the ramifications of their jobs which will enable them to obtain and retain employment. The ship owners' interests must be studied in every way, for if it is not profitable for Americans to operate our ships, none will be operated, and the thousands of really good men who are now earning their livelihoods from following the sea, will have to seek employment in other industries.

Everyone connected with American shipping must go into this contest in spirit as well as in work. We must have faith in our own efforts, for without faith and a spirit to conquer what seems overwhelming obstacles, we will meet defeat. It is not true Americanism to give up a task which seems insurmountable. If our forefathers had not the spirit to win, we would today be a dependent colony, and not the leading nation of the world.

Up and at it!

Ship Repairs Represent 13 Percent of Operating Costs—How Can This Item Be Reduced?

CAPTAIN R. D. GATEWOOD, Director of Maintenance and Repair, United States Shipping Board, suggests that a solution for this problem lies in creating a high morale among the crew, in closely checking the method of awarding repair contracts, in knowing the cost of repairs and in having an efficient port staff. He has written a special article for the June issue of MARINE ENGINEERING AND SHIPPING AGE "Efficient Repair Methods Adopted by the Shipping Board," in which he outlines what the Board has done to reduce repair costs.

In an article on "Economy in Ship Repairs" which will appear in the same issue, Robert W. Morrell, M.E., Marine Superintendent of the Tidewater Oil Company, outlines the maintenance problem confronting the independent operator. Mr. Morrell treats the subject of repair economy in its proper relation to the general scheme of successful steamship operation.

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Towing Model in Experimental Tank at Washington Navy Yard

Savings Possible With Properly Designed Propellers

Considerations Affecting Propeller Efficiency—Smooth Blades Cut Down Ship's Operating Costs 3 Percent—Wake Gain and Thrust Deduction

By Rear-Admiral D. W. Taylor, U. S. N. (Retired)*

POSSIBLE propeller efficiency depends primarily not so much upon the propeller itself as upon the combination of power absorbed, speed and revolutions for which the propeller must be designed. There is one other feature, however, which should always be given great weight, although the eternal compromise here must be between first cost and economy in service. I refer to the material used for blades. If this is an alloy which can be made very smooth in the first place and retains its smoothness fairly well between dockings, there will be great economy over cast iron or cast steel.

A paper by McEntee in 1916, before the Society of Naval Architects and Marine Engineers, is very significant in this connection. He tested four 16-inch propellers: Two of bronze, one of cast iron and one of cast steel. One bronze propeller was polished all over; the other three, all cast in the same mold, were tested as cast. The smooth propeller showed a maximum efficiency of 72 percent; the other three ran very close together, their maximum efficiency averaging 63 percent.

Smooth Propeller Blades Save 3 Percent of Ship's Operating Cost

In service, after a certain amount of corrosion and pitting on blades subject to it, it seems altogether likely that the above loss of 12½ percent would be increased as compared with smooth blades. The first cost of the latter blades will, of course, be greater, but if the cost of fuel used for propulsion is, say, 25 percent of operating expenses, and we save 12½ percent by the smooth blades, this saving will amount to some 3 percent of operating cost, and it will be nearly all net saving.

While considering this question of propeller friction, attention may be invited to the great loss of efficiency when propeller blades happen to harbor marine growth. This is more common with naval vessels, liable to make long stays in harbors where fouling is rapid, than with merchant vessels, but it is obvious from the experimental results quoted above that a very moderate fouling, hardly perceptible to the eye, will cause a notable loss of efficiency. McEntee investigated this matter also, and found that a very foul propeller might show an efficiency only 50 percent of one with smooth blades. The propeller blades on merchant vessels can hardly be cleaned by divers, as is frequently done on naval vessels, but, if some one will discover a suitable propeller blade material that not only does not corrode but does not foul, he would confer a boon upon owners of shipping.

While there is, of course, for every type of propeller one best design to meet a given set of conditions, it is possible to design any number of different propellers whose falling off of efficiency below the maximum possible is so small that no one would detect the difference in service. This is no doubt the reason for the prevalent belief that it is very hard to design an inefficient propeller. Nevertheless, it can be done, and when we consider our lack of information as to the actual conditions under which propellers operate, it is remarkable that it is not done more frequently.

As the result of hundreds of tests of model propellers the

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results of which have been made public, we are in a position to determine very satisfactorily a propeller that would drive a phantom ship—a ship that would show the resistance of the actual ship but would not disturb the water in any way. When, however, we consider the combination of actual ship and propeller, we at once get into trouble. The ship interferes with the propeller, so that the latter is usually essentially less efficient than if the ship were not there.

Wake Gain

This is not a large loss, however. A propeller, particularly that of a single-screw vessel, is working in a current—nearly always a following current or wake—caused by the frictional drag and the streamline and wave disturbances of the ship. This affords a possible gain of efficiency, if we can design our propeller to take advantage of it, but it seriously modifies the propeller design. Consider, for instance, a propeller to absorb 1,000 shaft horsepower on a single-screw 10-knot vessel. If the wake is equivalent to a uniform following current having 25 percent of the speed of the ship (by no means an excessive amount), the speed of advance of the propeller with reference to the water in which it works is not 10 knots but 7½ knots, requiring a larger propeller and a finer pitch than if the speed of advance were 10 knots.

Thrust Deduction

Unfortunately, also, there is a third factor wherein the actual ship differs from the phantom ship. The propeller cannot develop thrust without developing a certain amount of suction upon the after part of the vessel, thus increasing its resistance. We usually express this as a percentage of the gross thrust. This loss, on the average, is not far from the gain from the wake. The hull efficiency, as it is called, being the resultant of the wake gain and the thrust deduction, is usually somewhere near unity—seldom as much as 10 percent below or much more than 10 percent above. Both the thrust deduction and the wake vary with the characteristics of the vessel and the propeller size and location, and the only method known at present of approximating to them with good accuracy is that of an experimental investigation using models of hull and propeller.

In fixing upon the power for a ship, in case we have no line upon these factors of thrust deduction and wake, we can assume that they neutralize one another, or make a small allowance as a factor of uncertainty, but when it comes to designing a propeller we cannot do this. A positive wake necessitates a larger propeller than if there were no wake, and the thrust deduction, meaning more power so far as the propeller is concerned, also requires an enlargement of the propeller if we are not to lose efficiency from excessive slip. Hence, as to the propeller, these factors do not neutralize, but reinforce each other.

In practice, the increase in power necessitated by the thrust deduction is usually taken care of in the estimate of the power which must be delivered to the propeller. Assuming the power of the propeller determined accurately, if we knew the wake fraction, or ratio between the speed of the following wake and the speed of the vessel, we could design our propeller as accurately as for the phantom ship. Unfortunately, during the forty years since R. E. Froude's masterly paper of 1883, which for the first time, I believe, brought to the attention of naval designers these factors of wake and thrust deduction, experimental investigation has not enabled us to predict accurately the wake which a given screw in a given location with reference to a given hull will experience. However, the model basins of the world are going more and more into this matter. The last meeting of the Society of Naval Architects and Marine Engineers had a notable contribution on the subject from Professor Bragg of the University of Michigan, and there is little doubt that our present uncertainties in this connection will be resolved in a comparatively short time.

Fortunately, however, we can get along fairly well without exact knowledge of the wake factor. The important thing is to recognize the fact of its existence and not proceed with the design of propellers from model experiments as if our ships were phantom ships. This would result in propellers being too small, and the easiest way to spoil a propeller is to make it too small. Nearly fifty years ago the famous *Iris* showed that the propellers as fitted on that British man-of-war were too large, but times have changed and few of us nowadays have ever encountered a propeller that was too large.

How to Determine Wake Fraction

In order to design intelligently from the point of view of efficiency, making use of the enormous amount of experimental investigation of propellers that has been published, it is necessary to determine somehow the wake fraction to be allowed. Many designers do this by indirect methods. The best plan is to determine the wake fraction by experiment with a model of the actual ship, and the next best is to deduce it from analysis of an accurate trial of a ship closely resembling the one we are considering, with propeller similarly located. The latter requirement is very important, if we aim at minute accuracy. However, these methods are practicable in comparatively few cases. In 1910 I suggested the roughly approximate formulæ given below:

If w denote the wake fraction,
V the speed of the vessel,
V_A the speed of advance of the propeller,
and b the block coefficient of the vessel,
then speed of wake $= wV$

$$V_A = V\ (1-w)$$

$$w = -.05 + .5b \text{ for single-screw vessels,}$$

$$w = -.20 + .55b \text{ for twin-screw vessels.}$$

The above are based upon investigations published by W. J. Luke in 1910. The latest investigations indicate that the single-screw formula above is liable to give values to w a little high, and that the prismatic or longitudinal coefficient is a little better primary variable from a scientific point of view than the block coefficient. But taking ships as they are, until we are able to devise formulæ taking account not only of the fullness of the vessel but of the size and position of the propeller, the above roughly approximate formulæ are near enough for the purpose of propeller design when the first and second methods referred to above are unavailable. Probably, on the average, we will come a little closer to the single-screw wakes by using

$$w = -.10 + .5b$$

In any case, we will find large wakes for full, low-speed ships. Failure to realize the fact that these large wakes actually exist is liable to deceive us as to the efficiencies we are getting out of propellers. If the propeller of a single-screw ship shows in service an apparent slip of, say, 10 percent, we are apt to regard it as good. But suppose a 10-knot ship with a 25 percent wake shows an apparent slip of 10 percent. The speed of the propeller is 10/.9 = 11.11 knots. Then the apparent speed of slip is 1.11 knots. Adding the 2.5 knots of the wake, the true speed of slip is 3.61 knots, corresponding to a true slip of 0.325. In other words, the screw is working with a slip, not of 10 percent, but of 32½ percent and any screw working with a real slip of 32½ percent is wasting a lot of power.

Importance of Revolutions on Propeller Efficiency

There is one more or less controllable factor which has a major influence upon the possible efficiency of a screw propeller; that is the revolutions per minute. To survey this question, the results of systematic experiments with small propellers are of great value.

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Fig. 1 shows in a boiled-down form the limitations of a family of three-bladed propellers, all of the same blade width and the same root thickness of blade and covering the practicable range of varying pitch ratios. It is adapted from Fig. 212 of "Speed and Power."

If P denote the shaft horsepower, or power absorbed by the propeller,
V_A its speed of advance,
R its revolutions per minute,
and d its diameter in feet,

then, assuming Froud's law of comparison, we can deduce two dimensionless characteristics, as below:

$$\text{Revolution characteristic} = C_R = R\sqrt{\frac{P}{V_A{}^5}}$$

$$\text{Diameter characteristic} = C_d = d\sqrt{\frac{V_A{}^5}{P}}$$

These characteristics are independent of size, so from the results of experiments with the model propeller we can determine R, P and V_A and, hence, C_R and C_d, for any slip.

The curve for maximum efficiency is simply a line drawn tangent to the successive curves of efficiency for varying pitch ratios, all plotted on the C_R base, and the C_d line giving diameter characteristics for the maximum efficiency is simply a line joining the corresponding values of C_d. Of

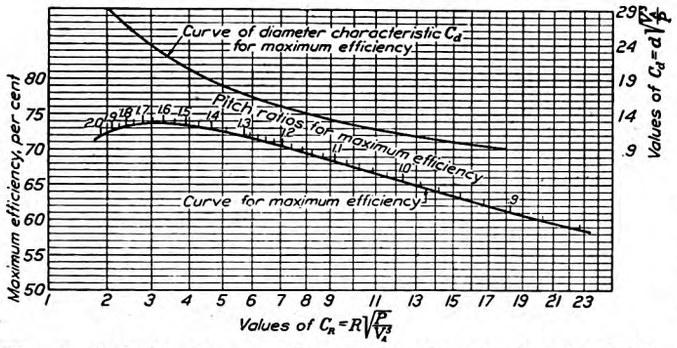
Curve of diameter characteristic C_d for maximum efficiency
Pitch ratios for maximum efficiency
Curve for maximum efficiency
Maximum efficiency, per cent
Values of $C_R = R\sqrt{\frac{P}{V_A^5}}$
Values of $C_d = d\sqrt{\frac{V_A^5}{P}}$

Fig. 1.—Relation Between Power, Revolutions, Speed of Advance of Propeller Through Water and Maximum Efficiency Possible for Propellers of Average Blade Width ¼ the Diameter and Maximum Blade Thickness 1/20 the Diameter

course the curves of Fig. 1 would be different for other blade widths and blade thicknesses, but these have comparatively small effect, the former in particular having much less influence than is usually ascribed to it. And, as a matter of fact, the efficiency of the propeller type to which Fig. 1 refers is about the best obtainable with propellers of uniform pitch and ogival blade section. The point is that the particular features of the curves of Fig. 1 are the same as any other family of propellers would show. Hence with fixed R, P and V_A we fix C_R, and hence the maximum efficiency obtainable. We may easily choose a diameter and pitch ratio that will absorb the power with a smaller efficiency, but nothing we can do as to diameter and pitch ratio will give us a greater efficiency.

The outstanding feature of Fig. 1 for present purposes is that for values of C_R found in practice the maximum propeller efficiency possible falls off steadily with increase of C_R. When C_R equals 3.5, the propeller efficiency, then at an absolute maximum, may be 73.5 percent or 74 percent. Double C_R and make it 7, and we have lost some 3 points of efficiency, our new possible efficiency being 70 percent. Again double C_R, making it 14, and our possible efficiency drops to a little over 64 percent, that is, 9½ points below the efficiency possible when C_R equals 3.5. This is a loss of about 13 percent based on the absolute maximum of 73.5.

Now the only controllable factor subject to material variation which enters into C_R is R, the revolutions of the propeller. Hence, unless we increase the number of screws, the only way to keep C_R down is to keep the revolutions down. Unfortunately about every other factor in the situation impels us to keep the revolutions high. With high revolutions the propeller is smaller, while the engines are smaller, lighter and cheaper, and, frequently, as in turbine drive, more economical. Compromise between the conflicting considerations is necessary, but it should be made with full knowledge of what we are doing. For instance, by adopting high revolutions we may lose 5 percent of propeller economy. If we gain 5 percent of fuel economy, there is no net loss in operation, and we have a cheaper and lighter engine. If we gain no fuel economy, we have a net loss in operation of 5 percent of fuel cost, and it is hardly likely any saving of first cost would offset this perennial drain from fuel loss.

Difficulties Involved in Design of Propeller for Large Low-Speed Vessel

Table I illustrates the difficulties confronting the propeller designer in the case of large low-speed vessels. Vessel No. 1 is a 10,000-ton deadweight tanker, which on trial, loaded, showed a maximum speed of 12 knots. As far as propeller design is concerned, however, the diameter and pitch in Table I would have been the same for 10 knots, or any other speed lower than 12 knots, provided always the variation of the power was as the cube of the speed throughout the range of speeds considered.

This is very closely true in this case, from 10 to 12 knots. We see from Table I, in the first column, that vessel No. 1 cannot avoid a rather low propeller efficiency. The revolution characteristic, in fact, was so high that the diameter characteristic had to be arrived at by extending the curve of Fig. 1.

The second column shows what could be done, if, by enlarging the cylinder diameters or length of stroke, we develop the same power at 60 revolutions. If we enlarge the propeller to about 21½ feet, which is practicable for the draft of water, we would increase the possible propeller efficiency to 0.63 a gain of about 7 percent over the 0.56 value. As a matter of fact, the gain would be slightly greater, and the diameter would not increase as much as indicated in the second column of Table I.

Table I.—Applications to Fig. 1

Conditions actual or assumed	Vessel No. 1		Vessel No. 2	
	As Tried	Assumed Reduced Revolutions	Twin Screw Actual	Single Screw Assumed
Sped of vessels in knots.....(V)	12	12	12.5	12.5
Revolutions per minute.....(R)	83.5	60	115	115
Shaft horsepower.....(P)	2,852	2,852	1,700	3,400
Block coefficient.....	0.801	0.801	0.75	0.75
Estimated wake fraction.....	0.30	0.30	0.20	0.20
Speed of advance .....(V_A)	8.4	8.4	10	10
$R\sqrt{\frac{P}{V_A{}^5}}$ ..... (C_R)	21.8	15.6	15.0	27.8
Maximum propeller efficiency (Fig. 1)	0.59	0.63	0.634	0.56 about
C_d for same .....(Fig. 1)	8.13	9.80	10.03	
Pitch ratio for same.....(Fig. 1)	0.87	0.94	0.95	
$V\sqrt{\frac{P}{V_A{}^5}}$	2.19	2.19	1.30	
Propeller diameter from above	17.5	21.6	13.0	
Pitch ratio from above.....	15.2	20.3	12.4	

This gives us only a first approximation. For a second approximation we would make P only 0.93 of 2,852, and C_R would be reduced to a little over 15. Vessel No. 1 actually had a four-bladed propeller of a type slightly different from the type of three-bladed propeller to which Fig. 1 applies, but the effect of change of revolutions upon effi-

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ciency would be substantially the same. The apparent slip on trial was about 5 percent only, but for a wake fraction of 0.30 the actual slip would be 0.34, a different thing.

Vessel No. 2 is a large twin-screw motorship. With increasing confidence in oil engines, there is a desire to fit single screws instead of twin screws on motorships. Table I shows that in this case there would be a very serious loss of efficiency by doing this.

The cases in Table I are fairly typical, and the large low-speed cargo vessel is usually fated from the first to have a low propeller efficiency. One line of amelioration would be the adoption of a type of propeller adapted to give a higher efficiency at large values of C_R than the standard type to which Fig. 1 refers. I believe a thorough investigation would show a possible gain of at least 5 percent for C_R values of 20 or thereabouts. Even so, the efficiency would be less for large than for small values of C_R, and lower revolutions would always result in a gain in propeller efficiency.

In the above, I have taken no account of cavitation. That is a special trouble where the law of comparison upon which Fig. 1 is based fails because the motion around the full-sized propeller differs from that around the model. Fortunately, for vessels where economy is a prime consideration, the conditions are seldom such as to involve danger of cavitation. This is a trouble of the extremely high-speed vessel.

Three-Bladed Propeller Slightly More Efficient Than Four-Bladed

It may be remarked, in conclusion, that there is one matter affecting efficiency where the practice of naval and merchant ship designers seems widely at variance. I refer to the number of blades used. Broadly speaking, naval practice is to use three-bladed propellers, merchant practice is to use four-bladed propellers. Model experiments indicate a small but distinct superiority, as regards efficiency, for three-bladed screws. The difference is so small, however—not over 3 or 4 percent—that it would be hard to demonstrate on full-sized ships except by most careful and rather expensive experiments. For my part, I believe that such experiments would bear out the model experiments and show a slight advantage as regards efficiency for the three-bladed propeller. Of course there are other factors involved, as where conditions require the minimum possible diameter. In such cases the four-bladed propeller might be slightly superior.

Important Advance in Pump Valves Decreases Cost of Pumping

USERS and prospective users of pumps will be interested to know that some decidedly valuable improvements in pump valve construction are now announced by the Worthington Pump and Machinery Corporation, of New York. An entirely different form of valve has

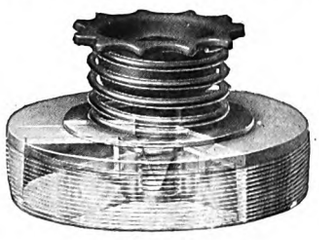

Fig. 1

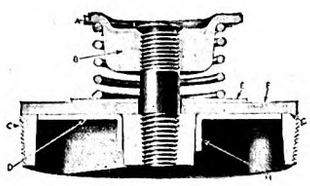

Fig. 2

been perfected which, when applied to service conditions that have been difficult for the older standard valves by causing them to cut and to leak, will eliminate both difficulties. It therefore increases the average pump efficiency; decreases the cost of pumping; and continually maintains the capacity of the pump at its maximum point.

After many years of building and operating pumps, the Worthington engineers have found that the principal cause of leakage is traceable to the excessive wear on the rubber, which while negligible in some cases is often quite bad. Thus Fig. 3 shows a photograph of a hard rubber valve after three months of a particularly hard service. Cracks and cuts caused by the valve seat and by the radiating ribs are plainly visible. Fig. 4 shows a medium rubber valve, also after three months of unusually difficult service. It is plain that the only way positively to prevent leakage with such ordinary valves in this condition is to remove and replace them with new valves.

To overcome this rapid and costly wearing, cutting and cracking action, the Worthington engineers have evolved the

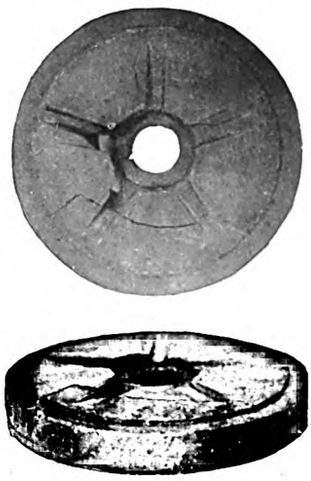

Fig. 3

Fig. 4

new and novel type of valve shown in Fig. 2, known as the Worthington "Seal" valve for use when the conditions are too hard for the ordinary form of valves now in standard use.

This new "Seal" valve assures absolute tightness when closed, the manufacturers claim, because the rubber used is "flexible" and will always seat perfectly both at the hub and outer rim, its inner and outer seats, and so keep tight. Age and continuous usage do not cut grooves or cause cracks as has been demonstrated in the case of a flexible rubber seal used for one year in this new type of valve. At the end of the year there was no visible wear, there was no leakage, renewal was of course unnecessary and there was no cost for repairs.

The ingenuity and simplicity of this valve are evident upon inspecting Fig. 2. There are no screws, no bolts, no rubber rings, no nuts, no bushings, no rotating elements. The special new feature that makes this valve so good for hard service is the so-called "bottom plate." This is in effect a middle seat for the rubber valve proper. When the valve is closed this middle seat carries the entire load and prevents the rubber seal from cutting on the seats or ribs. This bottom plate moves up and down with the rubber, and so not only acts as a middle seat, but this middle seat is movable with the rubber and helps to keep the rubber valve in shape even when open. Thus all mechanical functions requiring strength and wear resistance are cared for by metal parts. The flexible rubber acts only as a seal against leakage.

All moving parts are light but made amply rigid. The lightness assures a smooth, quiet-running pump. The rigidity prevents the distortion that results in leakage.

It is not anticipated that repairs or replacements will be often required but the construction makes this easy when it does become necessary, and the cost of any possible repairs will be low because of the simplicity and inexpensiveness of all parts.

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Efficiency Depends on Accurate Performance Records

Great Advantage in Knowing What a Vessel Is Capable of Accomplishing and Giving the Personnel a Mark to Shoot At

By C. J. Jefferson*

THE fundamental rule of sound business success is an accurate and true knowledge of production, selling and distribution costs for that business.

Temporary combinations of events may apparently disprove this axiom and while these circumstances exist, business success will occur in spite of the lack of this necessary primary knowledge. Then when the affairs of the world tend to restore themselves to normalcy, or perhaps subnormalcy, the temporary period of success is broken down and due to the lack of the basic cost data, the problem instead of being met with good keen business judgment is treated with a wild hysteria which generally succeeds in completely demolishing the one time successful businesss.

It is this lack of cost data and an intelligent analysis of the various items that make up the basic cost which has resulted so disastrously to the numerous shipping companies that sprang up during the war time emergency when cost principles were ignored. It is this same lack of cost data which perhaps in a lesser degree makes the problem of the American merchant marine today so intangible and so subject to panicky attacks from both its friends and enemies.

There is, however, any number of good reasons why these basic costs have not been established. First of all, we have been willing to accept the statement that it costs more money to run our ships than it does for those operated under foreign flags and therefore instead of establishing a selling price by the true though more difficult method of first determining the basic cost, we have let our competitors set our sales price for us and we have endeavored to meet it.

This is not good business nor can a business established on this foundation carry on itself when outside help is withdrawn. The problem of establishing the basic cost is complicated, for the shipping business is subject to more variables, and each of these variables has a more definite effect than is the case in any other business.

The basic cost can be divided into five main divisions:

1. Maintenance and depreciation of equipment.
2. Insurance.
3. Cost of soliciting cargo.
4. Stevedoring.
5. Operation.

All of these divisions are more or less interlaced and yet each heading must be analyzed by people who are qualified in their particular phase of the question and their findings must be co-ordinated by a single head who shall establish the proper co-efficient for each value and unite the findings into a basic cost.

It is not possible in such an article as this to go into the details of organization or the necessary tabulations that must be made in each of these divisions in order that reasonably correct values can be established. In fact, the various routes of trade, the various types of cargo and service make it impossible to cover the entire merchant marine field with any one definite program of attack.

Form for Collection of Operating Data Prepared

The force of the above statement has been made very evident to the writer in his work in the United States Shipping Board's Fuel Conservation Section, in establishing the standards of performance for the United States Shipping Board vessels operating in different routes of trade. The chief difficulty has been to get the available data regarding the performance of engine department of the various vessels in such standard form that it could be compared to the performance of sister ships and in turn make possible comparison of one class with another, at the same time making due allowance for the various variables such as efficiency of personnel, efficiency of material, weather conditions, drafts and speeds, bottom conditions, ocean currents and numerous other variables. To this end the accompanying form has been drawn up and is now used. On this form, the operating data for the entire voyage are collected in a compact form suitable for analysis and comparison.

Sheet No. 1 contains the characteristics of the vessel under analysis, also a brief statement of the physical condition of the vessel on arrival at the termination of the voyage. This being made out by an inspector who boards the vessel as soon as possible after she has docked, and in some cases the vessel is boarded at Quarantine when he rides her up to the dock.

The ratings of the engineer officers as to "mechanical ability," "discipline," and "efficiency," are based on the observation, both of the men and the condition of the equipment of the department as well as an analysis of the performance throughout the voyage. This means intelligent analysis of their work list abroad and at home, careful inspection of the department to determine whether the equipment is functioning properly and is not simply well painted, that bilges and tank tops as well as floor plates are clean, that dangerous fire hazards due to fuel leaks and oil-covered tank tops and bilges are eliminated.

In fact it means an inspection and an analysis of actual conditions made by a careful and efficient engineer who will not be influenced by the personality of the operating force.

How Ratings Are Estimated

The ratings given for personnel are based on general performance of the engine department crew. This is partially based on observation by the inspector, but must largely be made up according to their report of performance as given by their engineer officers. The equipment rating is based on observation and the operation rating is based on analysis of the physical condition and also on the efficiency of performance of the vessel for the entire voyage.

On a small chart on the bottom of Sheet No. 1 is roughly plotted the voyage so that the route can be seen at a glance. This is useful in cataloging the reports for comparative purposes.

Sheet No. 2 of this report is made up of a number of columns. Each column is given over to the different passages of the voyage. In case there are a greater number of passages than can be tabulated on this single sheet, any number of such sheets may be added to cover the entire voyage. These columns contain data which cover the major variables which will be met in operation and enable the person who is making an analysis of the voyage to locate the weak points of operation and make such recommendations as are necessary to improve conditions and build up the efficiency of operation.

The fuel performance is broken down into several factors such as fuel per twenty-four hours, miles per ton of fuel,

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UNITED STATES SHIPPING BOARD

VOYAGE REPORT — **PORT OF NEW YORK**

S.S. _____ OPERATORS _____ VOYAGE Nº VESSEL ____ VOYAGE Nº OPERATOR ____

DESCRIPTION OF VESSEL

BUILDERS		TYPE		DESIGNED DWT.		Δ
LENGTH	BEAM	DRAFT	SPEED	AT	R.P.M.	PITCH
ENGINE	H.P. RATED		LAST OPENED	LAST DRY DOCK		ANN. INSP. DUE
Nº BOILERS	TYPE		FUEL TYPE	QUALITY		

DATE — INDICATOR CARDS

R.P.M.	PORT H.P.	PORT I.H.P.	PORT 2 I.H.P.	PORT L.P.	R.P.M.	STARBOARD H.P.	STARBOARD I.H.P.	STARBOARD 2 I.H.P.	STARBOARD L.P.
I.H.P.					I.H.P.				
% LOAD					% LOAD				
CUT OFF					CUT OFF				

REMARKS

PERSONNEL

ENGINEER	NAME	MECHANICAL ABILITY	DISCIPLINE	EFFICIENCY
CHIEF				
1ST ASST.				
2ND ASST.				
3RD ASST.				
4TH ASST.				

REMARKS

PERSONNEL	EQUIPMENT	OPERATION
A	A	A
B	B	B
C	C	C
D	D	D

REMARKS

FUEL SUMMARY

FUEL ON BOARD LEAVING	TONS
FUEL PURCHASED AWAY	TONS
FUEL ON BOARD ARRIVING	TONS
TOTAL FUEL CONSUMED	TONS

PRESENT PHYSICAL CONDITION

	RATE
ENGINE ROOM	
MAIN ENGINES	
PUMPS	
CONDENSERS	
DYNAMOS	
REFR'G MACHINERY	
BOILER ROOMS	
BOILERS	
FURNACES	
BURNERS	
HEATERS	
F.O. HEAT. COILS	
PLUMBING	
HEATING	
LIGHTING	
STEERING ENG.	
WINDLASS	
WINCHES	
HULL	
TANKS	
DECK	
CARGO HOLDS	
QUARTERS	
ROOMS	
DECK HOUSES	
REMARKS	

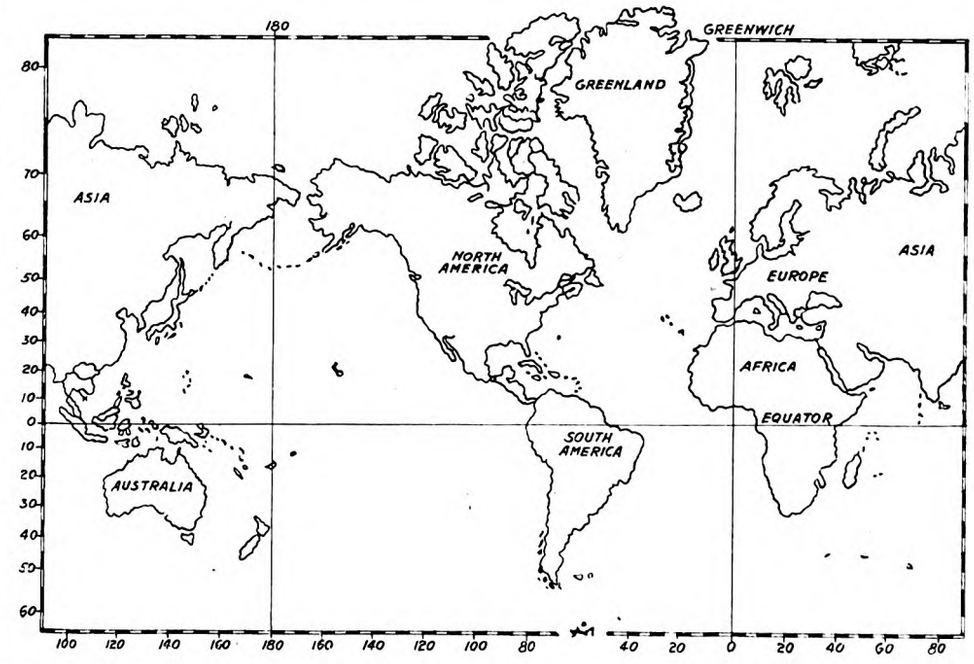

Fig. 1.—Sheet No. 1 of Vessel Performance Record

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S.S._____ VOYAGE ____

PASSAGE	FROM DATE																	
	TO DATE																	
PASSAGE CONDITIONS	1	DURATION PILOT STATION TO PILOT STATION	D. H. M.			D. H. M.			D. H. M.			D. H. M.			D. H. M.			D. H. M.	
	2	OBSERVED DIST. MILES PS-PS																
	3	HOURS REDUCED SPEED																
	4	HOURS STOP																
	5	REASON																
	6	WEATHER CONDITIONS																
	7	DRAFT LEAVING	FORD		MEAN			MEAN			MEAN			MEAN			MEAN		
			AFT		FOR			FOR			FOR			FOR			FOR		
	8	DRAFT ARRIVING	FORD		PASSAGE			PASSAGE			PASSAGE			PASSAGE			PASSAGE		
			AFT																
	9	DISPLACEMENT TONS Δ																
CARGO	10	CARGO TONS																
	11	CARGO TYPE																
PASS'GS	12	PASSENGERS	FIRST CLASS															
			SECOND CLASS															
			THIRD CLASS															
BALST	13	BALLAST TONS																
	14	BALLAST TYPE																
SPEED	15	WHEEL KNOTS																
	16	OBSERVED SPEED KNOTS																
	17	PER CENT SLIP %																
	18	AVERAGE R.P.M.																
OPERATING CONDITION	19	BOILER PRESSURE																
	20	H.P. CHEST PRESSURE																
	21	VACUUM GAUGE TEMP.																
	22	SUPERHEAT																
	23	H.P. CYL. C.O. OR Nº OF NOZZLES																
	24	AVERAGE H.P.																
	25	AUX. EXHAUST BACK PRESS.																
	26	SEA INJECTION F°																
	27	OVERBOARD DISCHARGE F°																
	28	BOILER FEED F°																
	29	STACK TEMP. F°																
	30	FURNACE DRAFT INS.																
WATER	31	FRESH WATER 24 HRS. TONS																
	32	FRESH WATER TOTAL TONS																
OIL	33	LUBRICATING OIL 24 HRS. GALS.																
	34	CYLINDER OIL 24 HRS. GALS.																
FUEL PERFORMANCE	35	HRS. DOCK PILOT STA.	TO															
			FROM															
	36	FUEL CONS. DOCK P.S.	TO															
			FROM															
	37	FUEL CONS. AT SEA	TONS															
			BBLS.															
	38	FUEL CONS. 24 HRS.	TONS															
			BBLS															
	39	LBS. FUEL PER H.P./H R.																
	40	LBS. FUEL PER MILE																
	41	MILES PER TON ACTUAL																
	42	MILES PER TON STANDARD																
	43	EFFICIENCY																
PORT OPERATION	44	PORT OF																
	45	Nº OF DAYS IN PORT																
	46	TOTAL PORT CONS. TONS BBLS.																
	47	AVE. DAILY FUEL PORT CONS. TONS BBLS.																
	48	Nº OF BOILERS USED IN PORT																
	49	Nº OF WINCHES USED IN PORT																
	50	WINCH HRS.																

		VOYAGE EXPENSE	AMOUNT	COST	
	51	FUEL ABROAD			SIGNED ENGINEER INSPECTOR
	52	WATER ABROAD			SIGNER HEAD FUEL CONSERVATION SECTION
	53	STORES ABROAD			
	54	REPAIRS ABROAD Nº_ E__ D__ S__ COST _____			SIGNED CHIEF ENGINEER INSPECTOR
	55	REPAIRS AT HOME Nº_ E__ D__ S__ COST _____			

Fig. 2.—Sheet No. 2 of Vessel Performance Record

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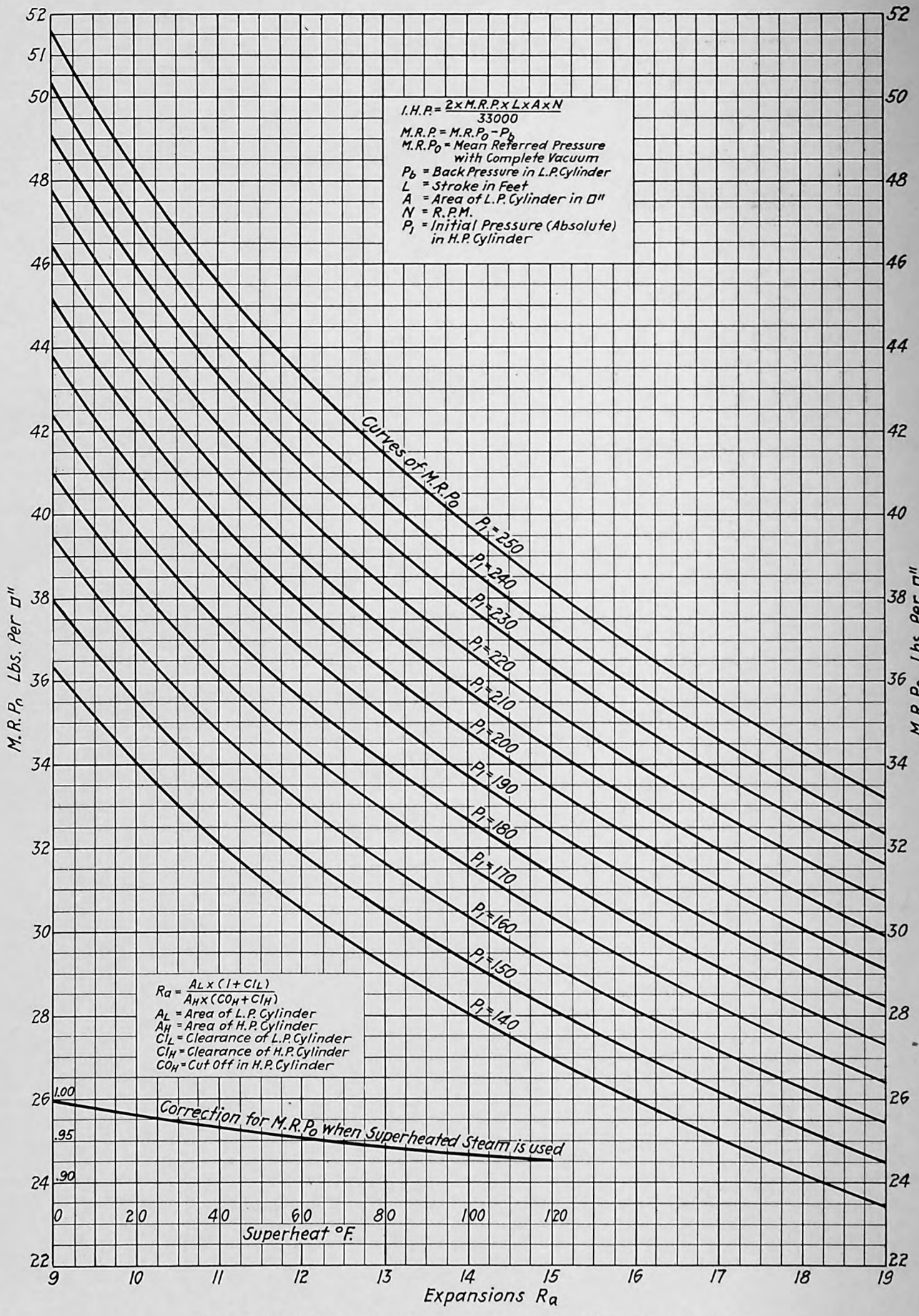
I.H.P. = 2 × M.R.P. × L × A × N / 33000
M.R.P. = M.R.P$_o$ − P$_b$
M.R.P$_o$ = Mean Referred Pressure with Complete Vacuum
P$_b$ = Back Pressure in L.P. Cylinder
L = Stroke in Feet
A = Area of L.P. Cylinder in □"
N = R.P.M.
P$_1$ = Initial Pressure (Absolute) in H.P. Cylinder
Curves of M.R.P$_o$
P$_1$ = 250
P$_1$ = 240
P$_1$ = 230
P$_1$ = 220
P$_1$ = 210
P$_1$ = 200
P$_1$ = 190
P$_1$ = 180
P$_1$ = 170
P$_1$ = 160
P$_1$ = 150
P$_1$ = 140
R$_a$ = A$_L$ × (1 + Cl$_L$) / A$_H$ × (CO$_H$ + Cl$_H$)
A$_L$ = Area of L.P. Cylinder
A$_H$ = Area of H.P. Cylinder
Cl$_L$ = Clearance of L.P. Cylinder
Cl$_H$ = Clearance of H.P. Cylinder
CO$_H$ = Cut Off in H.P. Cylinder
Correction for M.R.P$_o$ when Superheated Steam is used
1.00
.95
.90
0 20 40 60 80 100 120
Superheat °F.
M.R.P$_o$ Lbs. Per □"
M.R.P$_o$ Lbs. Per □"
52 51 50 48 46 44 42 40 38 36 34 32 30 28 26 24 22
9 10 11 12 13 14 15 16 17 18 19
Expansions R$_a$

Fig. 3.—Chart for Determining Horsepower of Reciprocating Engines

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fuel per horsepower hour during steaming period at sea. The fuel per horsepower hour factor, while one of the most important is one most difficult to obtain accurately and must therefore be used very guardedly.

In the case of turbine-driven vessels, the shaft horsepower factor is determined from the horsepower curves of the turbine and the average logged revolutions per minute, initial steam pressure, vacuum, and number of nozzles used for this determination.

In the case of reciprocating engines, actual cards are worked out. Then from the measured cut-off, initial pressure and back pressure taken from these same cards, the horsepower is computed, using the curves shown on Fig. 3. The relation of the actual to the theoretical horsepower gives the card factor. Then from the logged high pressure cut-off, high pressure chest pressure, the revolutions per minute and the vacuum or low pressure back pressure, and using the above mentioned back pressure, the indicated horsepower for each passage is computed.

PORT CONSUMPTION

The fuel consumed in port, both at anchor and in moving from dock to pilot station, and from pilot station to dock is tabulated so that an excellent sea performance may be checked and shown not to have been made at the expense of excessive port consumption. The efficiency of performance is based on the ratio of actual miles per ton of fuel to the standardized values. The methods of obtaining these standardized values has been explained in previous articles in this publication.

In determining these standards, this form of voyage report has been found most useful and by continuing to check the standards with these reports, the standards will be gradually revised so that they take care of a greater number of variables than was possible at the time they were originally drawn up. It is felt that this voyage report form when used by competent and experienced engineers will give the data for the engine department operation in such a form that the co-ordinator can set his co-efficient on this phase of the basic cost with a reasonable degree of certainty.

In addition to this, however, it will be necessary to handle the other phases in as thorough a manner and when the merchant marine business is subjected to this type of scrutiny, then will it be able to establish a sound business foundation which will enable it to meet fluctuating markets, crises in the affairs of the world's trade, peak loads and depressions, and still carry on its business in a safe, sane and sensible manner. When those times arrive which are so apt to arrive in any business, when the life of the business hangs on the decision of the moneyed powers or even the Government itself, as to whether or not it be given aid, then the facts of the case, through reliable back cost figures can be so presented that a just and fair decision can be rendered, help given and remedy applied so that the business can continue to function. then will the merchant marine be a reliable business which other big business systems will support.

Appendix

METHOD OF USING RECIPROCATING ENGINE HORSEPOWER CURVES

Having determined the value of R_a (see Fig. 3) read upward in vertical line P_1 curve which corresponds to the absolute initial pressure or absolute pressure in high pressure steam chest. At the point this vertical line intersects the P curve carry over on a horizontal line and read the mean referred pressure (with complete vacuum) value, which is the mean referred pressure on basis of absolute vacuum in low pressure cylinder.

This mean referred pressure (with complete vacuum) value is transformed into Mean Referred Pressure or M.R.P. by subtracting the back pressure (P_b) in low pressure cylinder.

Modern Boiler Room Economies

By J. J. Nelis*

MARINE engineers are naturally conservative, and the boiler being the heart of the power plant, in fact of the ship, they have been reluctant to make any changes that might cause operating delays. As a result of this there has been little, if any, change in marine boiler practice for a great number of years except a small increase in pressure and for certain large powers the adoption of the watertube boiler.

During the last few years land plants, where economy is paramount and reliability a secondary consideration due to their usually having spare boilers installed, a great number of vital changes as regards economy have been tried out and carried to a successful conclusion, so that these new devices are now standard practice.

CHANGES IN LAND BOILER PRACTICE

The three most important changes in land boiler room practice have been:

1. The adoption of better combustion methods, such as stokers and increased furnace volume. Neither of these have been found advantageous on ships to date, but are one of the possible future developments that will slowly but surely take place, particularly when the present era of oil fuel is passed, and most of the merchant ships are again using coal for fuel.
2. Another main change has been the adoption of superheaters which add to the amount of heating surface passed over by the hot gasses, thereby increasing the overall boiler economy, and also transfer to the steam heat units which increase the steam economy of prime movers and therefore the overall power plant efficiency.
3. The third main change has been the installation of economizers to add as nearly as possible all of the sensible heat to the water in a separate chamber where it can be more efficiently accomplished, and leaving to the boiler only the work of adding the latent heat of evaporation which is a duty that should be done by the boiler, and not, as at present in marine practice, using the boiler as a combined economizer and steam generator.

In present day practice, with a typical Scotch boiler installation using Howden or similar heaters to absorb some of the heat of waste gasses, the average boiler room economy, hand fired with coal, is about 60 percent of the total heat of the fuel. With a similar installation, using oil as fuel, an economy of not over 65 to 70 percent of the heat of the fuel is an average condition.

MEANS OF INCREASING BOILER EFFICIENCY

As against present day practice, it is possible in marine power plants at a relatively small cost, to add superheaters and economizers, giving an overall efficiency of not less than 85 percent of the heat in the fuel, which will closely approximate the economy found in large central stations ashore.

The above is based on using the present equipment aboard ships. It is possible when building new ships to arrange for a considerable increase in furnace volume, and also in steam pressure. The latter, however, will require new types of prime movers but, if installed and intelligently operated, will place the American merchant marine ahead of all its competitors as regards the economy of its boiler room and complete propelling equipment.

The new inner harbor-navigation canal at New Orleans, La., which has been built by the Board of Commissioners of the Port of New Orleans, an agency of the State of Louisiana, at an expense of $20,000,000, will be formally opened on May 5. This canal connects the Mississippi river with Lake Pontchartrain.

* Secretary, Foster Marine Boiler Corporation, New York.

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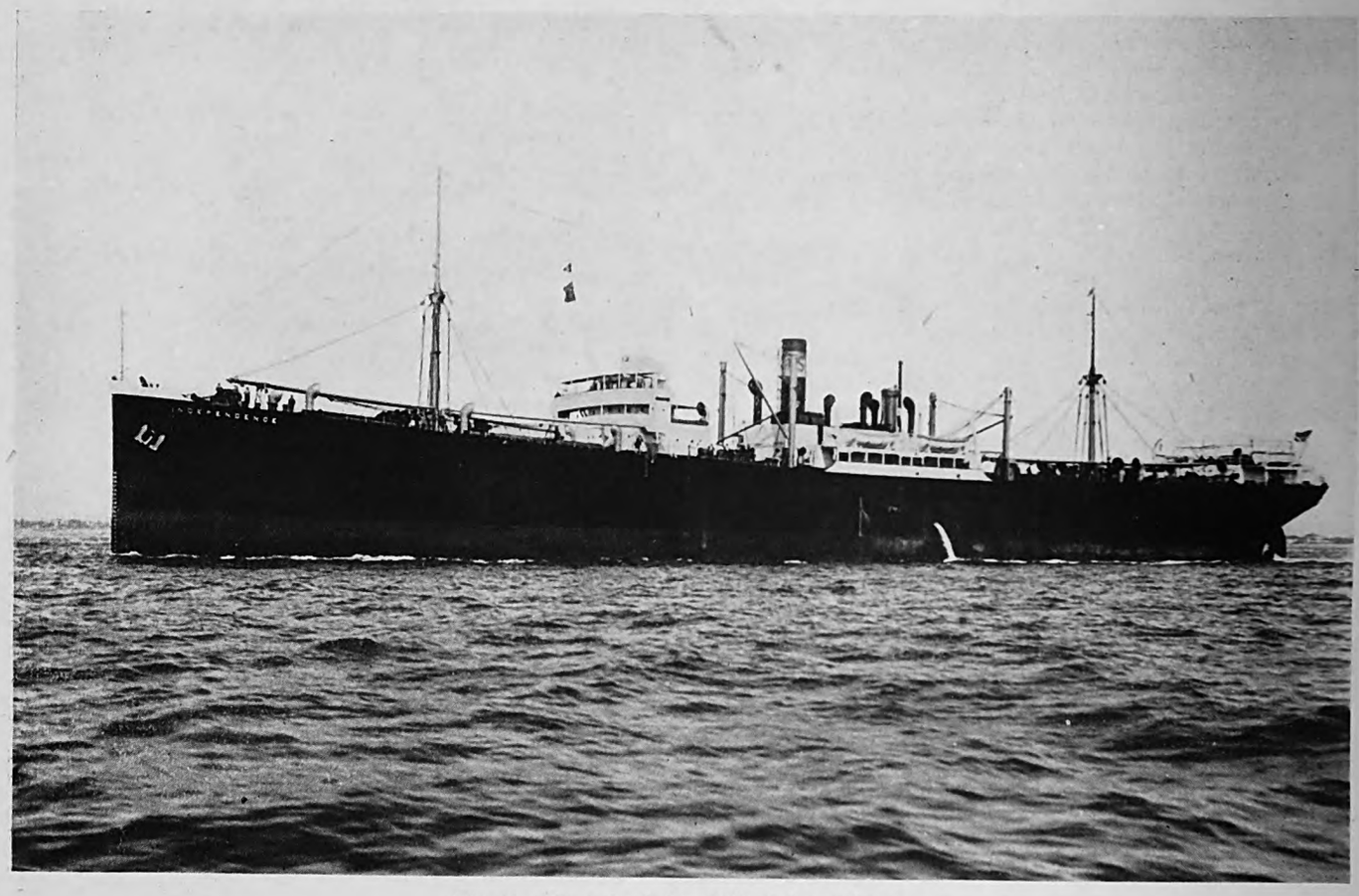

Fig. 1.—Electric Drive Ship Independence

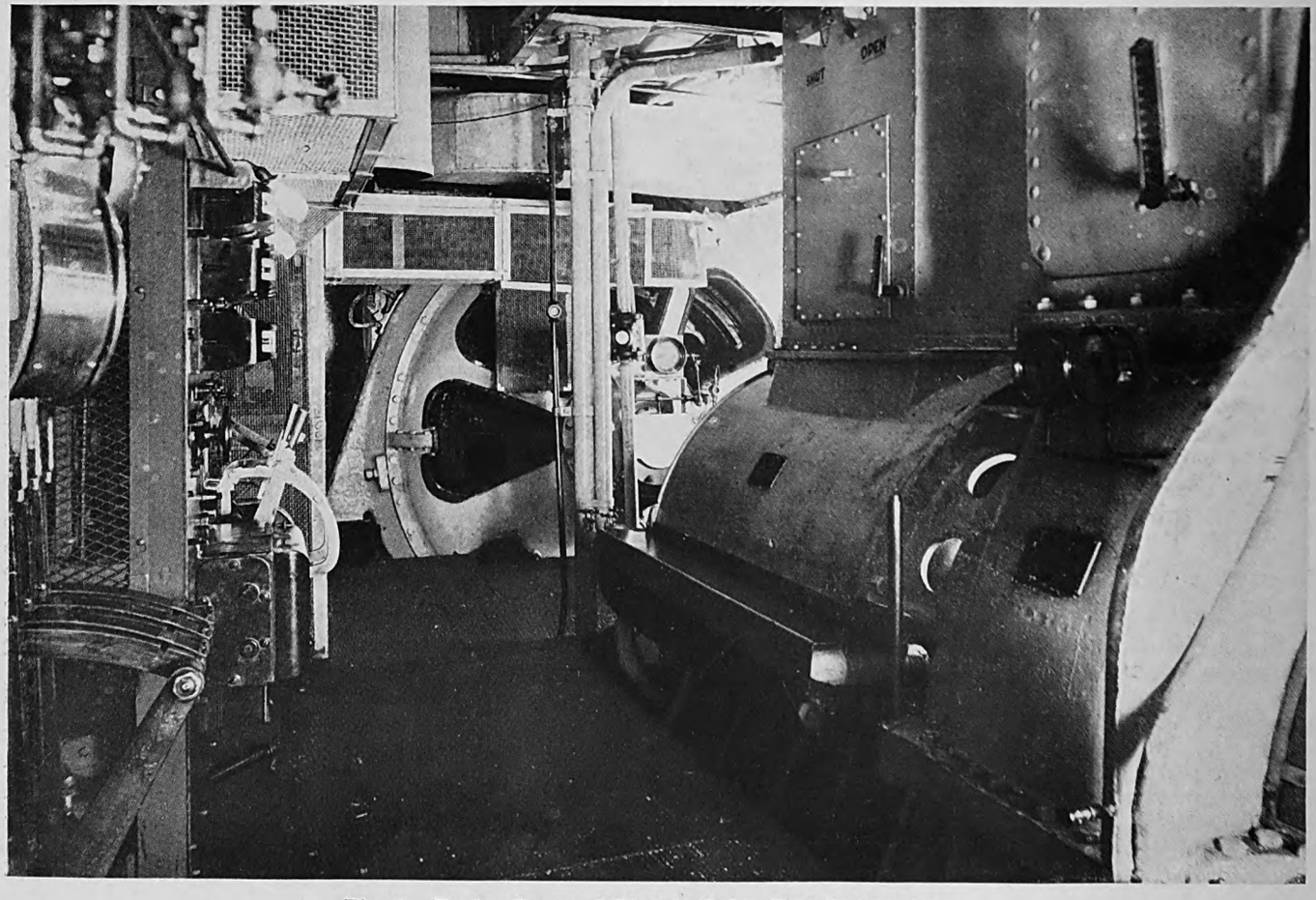

Fig. 2.—Engine Room of Electric Drive Ship Independence

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How to Get a Shaft Horsepower Hour for All Purposes with Steam on from 0.75 to 1.00 Pound of Oil

By W. C. Watson and John Thomas*

No appreciable departure from established marine practice has been made in the form of propulsion discussed in this article. The authors have had in mind primarily reconditioning work, retaining in many cases the same boilers, some of the original auxiliaries and adding superheaters. But the turbine electric apparatus described lends itself to the introduction into marine practice of many of the important features that have been developed in connection with large power houses on shore, such as, for instance, the adoption of high steam pressures and temperatures, as well as advanced systems of feed water heating and auxiliary layouts, including evaporators.

THE development of turbine electric drive for ships has been so rapid during the last few years, that many are unaware of the results that can be obtained with this form of propulsion and the contribution it can make to the American merchant marine in establishing it on a sound, economical and competitive basis.

At a time when so many ships must be reconditioned before they are competitive, careful consideration should be given to the possibilities of this form of propulsion.

The turbine can be designed in its simplest form. Reversing elements are eliminated, as reversal of the ship is accomplished by a simple change in electrical connections. The generator to which the turbine is directly connected is practically identical in design with the type employed in large power stations, and which has proven itself reliable twenty-four hours per day for years. The motor is direct connected to the propeller shaft and is of the steel mill type. The entire equipment is controlled by apparatus successfully demonstrated, particularly in steel mill and electric railway service, on shore.

In considering any form of propulsion reliability is the most important factor. In electric drive, we have apparatus which has successfully demonstrated itself for many years in the solution of difficult mechanical problems encountered on land and sea. No apparatus can be supplied to ships with as few changes from highly developed land practice as that comprising turbine electric drive.

Propelling Equipment

The propulsion equipment involves simple rotation, no rubbing surfaces other than journal bearings, and the power delivered to the propeller is transmitted across an air gap of considerable proportions, which is, for all practical purposes, an elastic medium, thus eliminating shocks and excessive stresses imposed upon the apparatus from the propeller and the elasticity of the ship's structure.

Figs. 3, 4 and 5 show rotors of the turbine, generator and motor respectively, and give a good idea of the rugged construction of the major rotating parts comprising complete electric drive equipment for a single screw ship. For the ordinary twin screw vessel there would be two turbine generators and two motors. In any turbine electric drive equipment the weight of the major rotating parts represents only about 30 percent of the total weight of the machines.

Figs. 6, 7 and 8 show complete propulsion turbine generator, motor and control apparatus. The principal electrical currents are generated in stationary parts, which affords the simplest and most reliable cable arrangements between generators and motors. The component parts of large electrical machines are by necessity mechanically strong, which introduces the highly desirable quality of maximum reliability into machines of this type.

Enough experience has been obtained during the last ten years with electrically driven ships to enable us to say that the cost of maintenance of this form of ship propulsion machinery is much less than that of any other type. Experience of large operators of reciprocating engine machinery indicates that the average cost of upkeep is several dollars per shaft horsepower per year, whereas experience with electrically driven vessels, such as the *Eclipse*, *Jupiter* and Coast Guard cutters, indicates that the cost is practically nil.

A ship maneuvers with turbine electric machinery much as it does with reciprocating engines, except that the turbine generator is not reversed, which greatly simplifies maneuvering and lessens wear and tear on the machinery. The efficiency is the same in the reverse direction as in the forward, also 100 percent power is available for astern operation.

Comparative Weights

In comparison with electric drive for small cargo vessels requiring from, say, 2,500 to 4,000 horsepower, the geared turbine is somewhat lighter. However, in the larger powers in the case of ordinary passenger and cargo boats, when it becomes necessary to break up the turbine into two or more units per propeller shaft, and the extra piping, cross over connections and oiling system are taken into consideration, the weight of electric drive is approximately the same as that of the geared turbines.

In some of the large liners the geared turbine installations are much heavier than equivalent turbine electric installations. In practically every case the turbine electric drive is about one-half the weight of reciprocating engines.

Increased First Cost Justified

As far as the costs are concerned, turbine electric drive is somewhat more expensive than geared turbines for ordinary vessels requiring from 2,000 to 4,000 horsepower per screw, but when the added reliability, low cost of upkeep and superior maneuvering ability, as well as excellent economy and flexibility of arrangement, are taken into consideration the increased first cost is justified in many cases. For vessels requiring above 4,000 shaft horsepower per screw there is very

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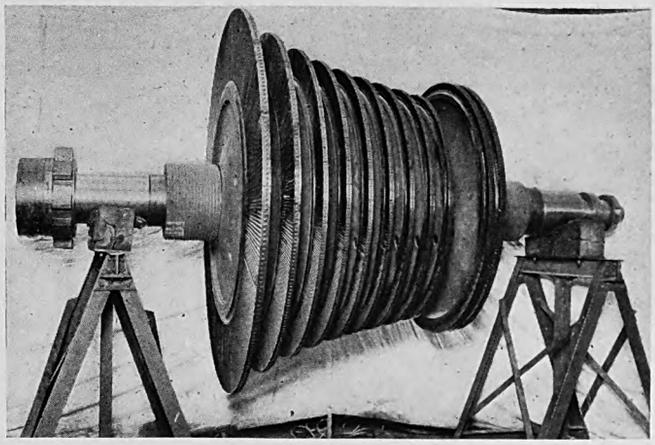

Fig. 3.—Propulsion Turbine Rotor

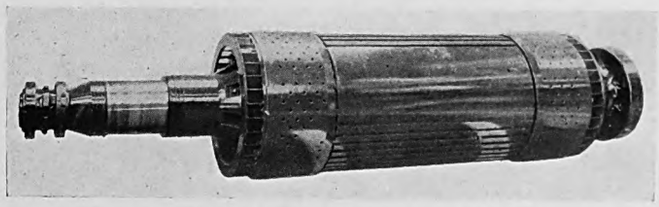

Fig. 4.—Propulsion Generator Rotor

Fig. 5.—Propulsion Motor Rotor

little difference in first cost between turbine electric drive and geared turbine drive, except in the case of certain passenger liners where electric drive would cost considerably less than geared turbines now used.

Aside from the advantages already mentioned, the special contribution which electric drive can make to the solution of the ship operators' problem is dependent upon two special characteristics in which it is unique; first, the ease with which operating conditions can be measured and recorded, and, second, the ease with which the favorable conditions can be arrived at and controlled. The advantages of the first are not always frankly conceded. It has been said that the same

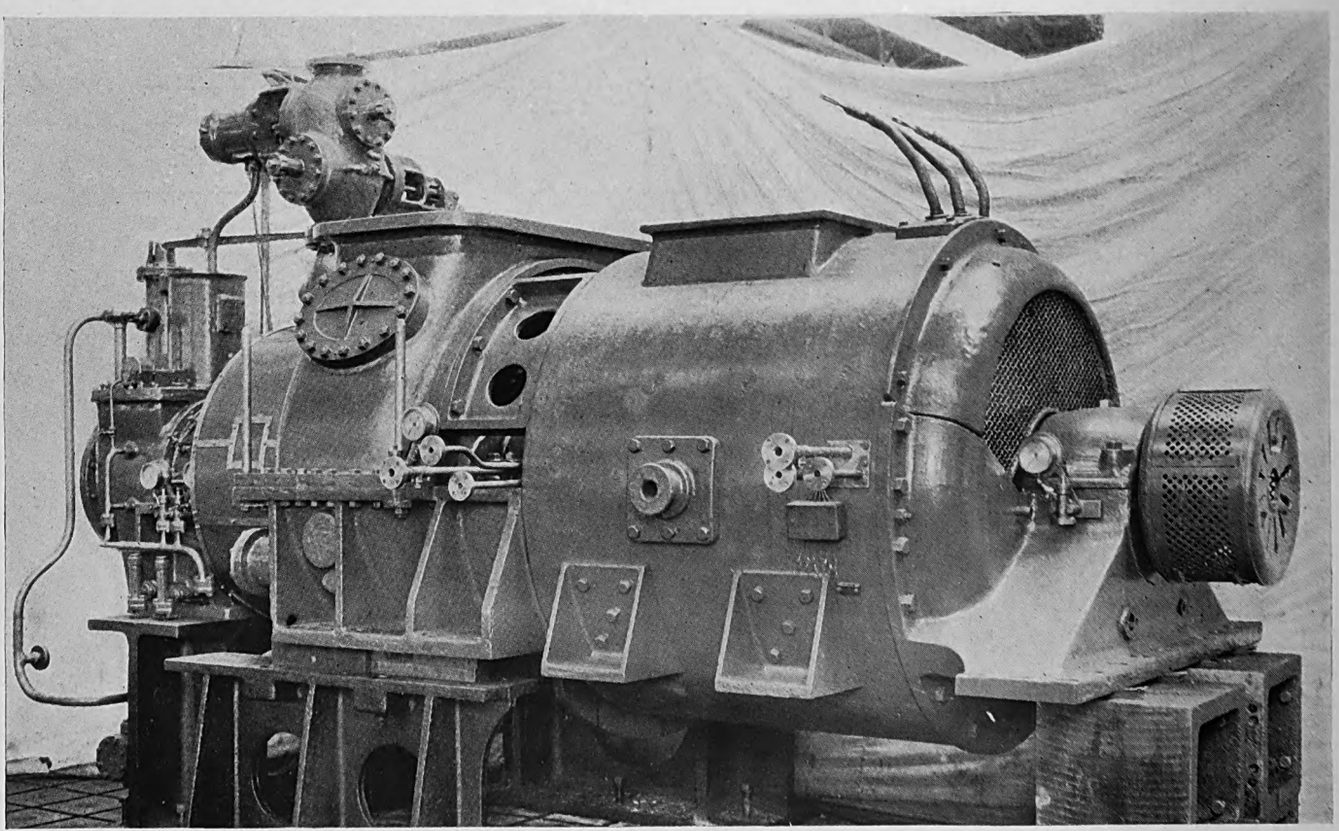

Fig. 6.—The Propulsion Turbine Generator

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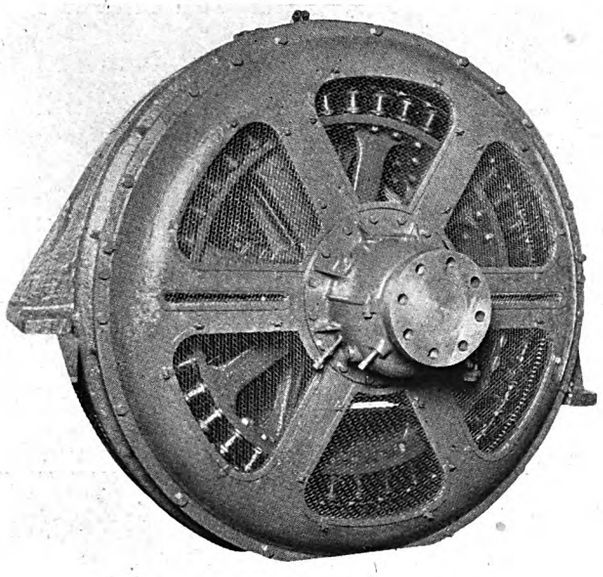

Fig. 7.—The Propulsion Motor

type of information could be obtained from log records of steam or fuel conditions. In actual practice this is not so on account of the many variable factors involved.

Operating Data Easy to Obtain and Apply

The torsion meter as applying to propeller shaft is a considerable advance over the steam engine indicator, but when it is applied to a limited number of ships it does not invite that easy accumulation of useful data for which the switchboard instruments of the electric drive equipments are so eminently suitable. Without interfering with the ship's regular schedule sufficient information may easily be obtained to show the effect of many factors on economical operation. The accurate data obtained on an electric drive vessel would not only enable the owner to operate that particular ship most economically, but it would be applicable to a fleet of vessels of their type. Most of the data is not only applicable to one type of motive power but to any type of motive power.

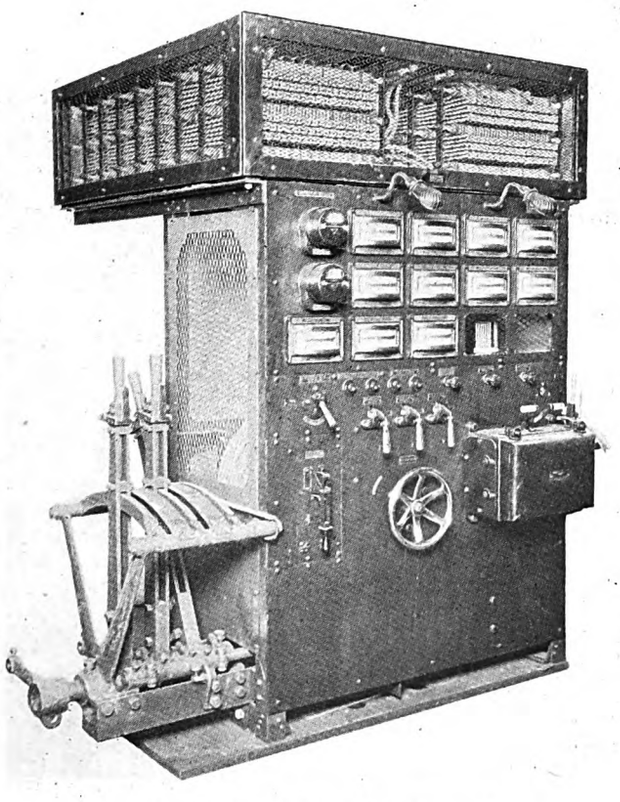

Fig. 8.—The Propulsion Control

A Shaft Horsepower Hour for 0.75 Pound of Oil

Most of the above factors are conceded by many, but few are aware of the fuel consumption possibilities, namely, that a shaft horsepower hour for all purposes can be readily obtained on from 0.75 to 1.00 pound of oil, depending upon size, type and trade route of the vessel, which is very much less than many present day steam installations.

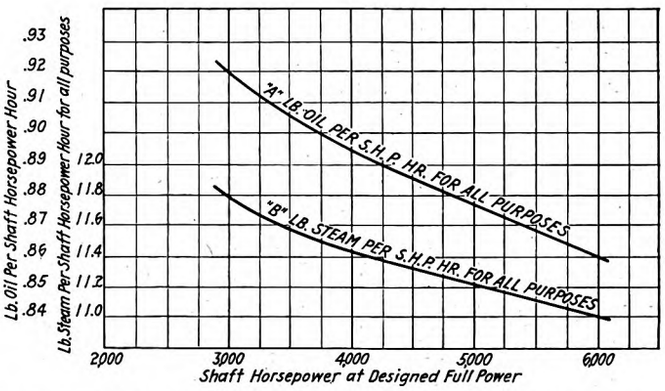

Fig. 9.—Fuel Oil and Steam Consumption for All Purposes for Single Screw, Electrically Driven Cargo Vessels Requiring from 3,000 to 6,000 Shaft Horsepower

Synchronous motor drive; propeller revolutions per minute, 100; steam pressure, 200 pounds gage; superheat, 200 degrees F.; vacuum, 28.5 inches. Assumptions: heat value of 1 pound of oil, 19,000 British thermal units; boiler efficiency, 75 percent.

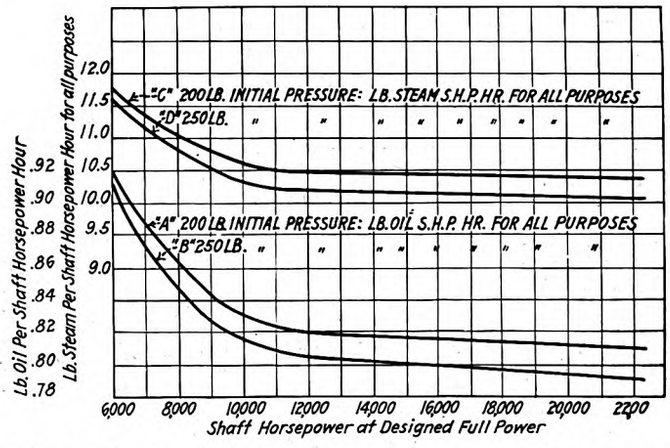

Fig. 10.—Fuel and Steam per Shaft Horsepower Hour for All Purposes for Twin Screw, Electrically Driven Passenger and Cargo Vessels Requiring from 6,000 to 22,000 Shaft Horsepower

Synchronous motor drive; propeller revolutions per minute, 115; steam pressure, 200 and 250 pounds gage; superheat, 200 degrees F.; vacuum, 28.5 inches. Assumptions: heat value of 1 pound of oil, 19,000 British thermal units; boiler efficiency, 75 percent.

For the ordinary cargo vessels of the single screw type requiring from 3,000 to 6,000 shaft horsepower at designed full load, Fig. 9 (curves A and B) shows what can be accomplished in the way of fuel oil and total steam for all purposes, with the exception of evaporators. The arrangement of auxiliaries selected is such as to give the desired amount of auxiliary exhaust steam at 10 pounds gage for heating the boiler feed to approximately 230 degrees F. with-

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Table I—Machinery Layout—Single Screw Vessels

Name	*Drive*
Main turbines	Steam
Light and ventilation fans	Electric
Excitation	Electric
Fans for ventilating propulsion motor	Electric
Refrigeration	Electric
Sanitary pump	Electric
Lubricating oil pump	Electric
Oil cooler circulating pump	Electric
Circulating	Electric
Feed pump	Steam
Forced draft blowers	Steam
Steering gear	Steam
Twin beam air pump	Steam
Oil pump for burners	Steam
Fresh water pump	Steam
Intermittent service pump, including fire, bilge, ballast, fuel oil transfer, etc.	Steam
Heating of fuel oil	Steam
Galley	Steam

Table II—Machinery Layout—Twin Screw Vessels

Name	*Drive*
Main turbines	Steam
Light and ventilation	Electric
Refrigeration	Electric
Steering gear	Electric
Lubricating oil pump	Electric
Oil cooler circulating pump	Electric
Fresh water pump	Electric
Sanitary pump	Electric
Excitation	Electric
Fans for ventilating propulsion motor	Electric
Feed pump	Steam
*Circulating	Steam
Forced draft blowers	Steam
†Air pump twin beam	Steam
Condensate pump	Steam
Air ejector (for 10,000 shaft horsepower and above)	Steam
Oil pump for burners	Steam
Intermittent service pumps	Steam
Heating fuel oil	Steam
Galley	Steam

*Electrically driven in the case of 6,000 shaft horsepower vessels.

†For 10,000 shaft horsepower vessels and above electrically driven condensate pump and air ejectors.

out admitting or extracting steam to or from the main turbine, and without admitting auxiliary exhaust steam into the main condenser. Table I lists in detail the selection of auxiliaries to accomplish the heat balance described above.

For passenger vessels and large freighters requiring twin screws and from 6,000 to 22,000 shaft horsepower at designed full load, Fig. 10 (curves A, B, C and D) gives the fuel and total steam per shaft horsepower for all purposes. As in the case of the single screw vessels, sufficient auxiliaries are driven by steam to produce a feed water temperature of approximately 230 degrees F. with auxiliary exhaust pressure of 10 pounds gage, without admitting or extracting steam to or from the main turbine, or exhausting auxiliary exhaust steam into the main condenser. Again evaporators are not included in these calculations. Table II shows the arrangement of the machinery.

In the analysis of both single screw and twin screw vessels the small turbine generators used for light, power and excitation will operate condensing under the same steam conditions as the main turbine, and at sea will normally exhaust into the main condenser, a small auxiliary condenser being provided for port and emergency use.

Electric Auxiliaries An Economic Necessity

Lines Along Which Our Efforts Must Be Expended to Minimize the Fuel Bills, Machinery Maintenance and Cost of Handling Cargo

By Walter Thau*

EVERY industry of any standing today has gone through a transition, forced by the necessity for lower costs, better and more uniform product and increased production. Of all the factors participating in these industrial revolutions, electricity stands indisputably first. Without electricity, the results could not have been obtained. Similarly, the ship must undergo a change, which is forced by the necessity for reduced operating cost and general economic improvements. Fortunately the movement has already received the impetus, and is successfully launched. The aggressive shipping interests already realize that great improvements in methods and performance are available by the use of electrical apparatus, and their interest in the situation is manifested today by a definitely increasing activity which is always a good indication of the outcome. Electricity will do for the ship what it has done for the steel mill, the mine, the logging camp, the textile mill, the rubber mill, the cement mill, and hundreds of varied manufacturing establishments.

Naturally enough the arrival of the motorship was almost simultaneously accompanied by the adoption of electrical auxiliaries. The builders of motorships soon recognized the waste encountered by the use of the donkey boiler and steam auxiliaries, and changed over to the all-electrical auxiliary system. This latter practice is in vogue almost universally today, a fact which furnishes sufficient proof of the suitability of electrical ship auxiliaries, as well as the resulting economies effected by their use. The motorship, which in itself constitutes a tremendously important step toward economy, therefore set, or at least hastened, the pace toward the ultimate answer in the economical operation of ships, even though their first installations of electric auxiliaries were considered somewhat in the light of a necessity. The performance of the electrical auxiliaries on motorships during the last 10 or 12 years has proven and thoroughly established their reliability for the service.

In the case of steamships, however, the conditions are somewhat different. Here there is plenty of steam producing means available, and, with few exceptions, practice has doggedly adhered to steam auxiliaries. This practice is deserving of some sympathy, however, even though the justification for it is not apparent. The attendants knew no other than steam machinery, and for the most part the equipment was built and supplied by the shipyards whose machine shop constituted no small proportion of the total plant. However, this is no time for accepting passive consideration of electrical auxiliaries, even on steamships. The future American competitive ship will be the ship equipped with electrical auxiliaries, regardless of its type of propelling equipment.

Economy in Fuel Consumption

The improved fuel economy of electrically driven machinery is due entirely to the great efficiency with which electricity can be generated, transmitted and used. The in-

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stallation of a flexible centralized generating plant makes it possible to convert the stored energy in fuel into a useful form of energy with the least expenditure of labor and with minimum losses. The transmission of electrical energy entails less loss of power than the transmission of energy in any other practical form. Furthermore, there are no losses in the electrical transmission systems when no power is being transmitted, which is a very important item when compared with the steam systems in which the condensation and leakage losses assume a considerable proportion, especially in cold climates. In the case of steam deck auxiliaries, the pipe line losses may easily amount to 25 percent in many cases. As a user of power, the electric motor supplied with energy from a central plant is in a class by itself, especially when compared with the donkey engine. These considerations are particularly important, in the case of deck machinery, steering gears and any machinery not located close to the boilers.

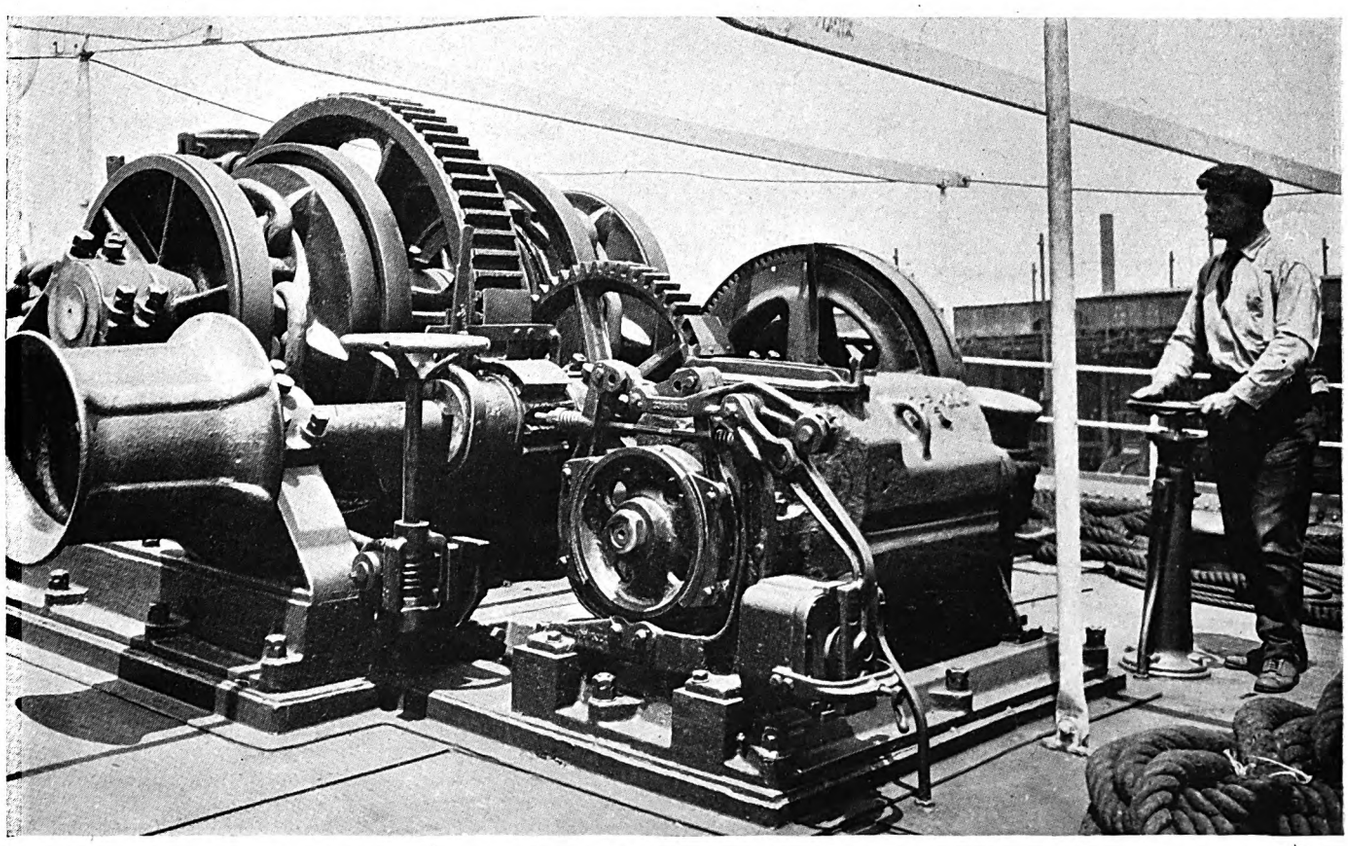
Upon our ability to reduce our operating costs to actual rock bottom depends our future as a maritime nation. It is of paramount importance, however, that any improvements bear strict economic analysis when viewed with the ship problem as a whole. We must not accept a particular system, if the net result does not show an economic gain, even though it may, for instance, effect a very attractive saving in fuel. The problem of transporting and handling cargo at the least possible cost per unit, with the quickest turn-around, and with real service to the shipper, requires that the highest possible economy of operation be attained.

For existing ships, we have available two kinds of generating plants, one in which the prime mover is the turbine, and the other in which the prime mover is an internal combustion or Diesel engine. From a service performance standpoint, either plant is entirely satisfactory. However, from a fuel consumption standpoint, the Diesel plant has much in its favor. In most cases, the type of prime mover will be dictated by the type of ship, that is, whether it be a steamship or a motorship. However, the Diesel driven generating plant must not of necessity be considered out of place on a steamship, as will be apparent later. Actually, the selection of the plant necessitates a complete economical analysis for the reason that our final interest is in the net monetary results.

The auxiliary equipment on a ship is conveniently classified into two groups, namely, the deck machinery, including the winches, windlass, capstan and steering gear, and the engine room machinery, including the pumps, compressors, blowers, etc. The deck auxiliaries present some very interesting application and design problems, whereas the engine room auxiliaries present no problems of any real interest or concern. The economical advantages of the electrical deck auxiliaries are readily established. In the case of the engine room auxiliaries, however, a deeper analysis is necessary to show the improvements to be gained by the use of electrical equipment. For this reason, the two classes will be discussed separately.

Deck Auxiliaries

Considerable difficulty is encountered in securing reliable data on the power consumption of steam winches. Such data as have been obtained by actual test vary considerably.



Electrically Operated Anchor Windlass on the Motorship William Penn

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Some of the variation can be acounted for by the difference in the hook loads, as it is obvious to those who have studied the field that the fuel required per ton of cargo handled varies considerably with the hook load, especially for loads under two tons. The remaining inconsistencies in the data are attributable to differences in condensation and leakage losses, differences in the initial and exhaust steam pressures, the relative condition of the engines, and the manner and method of handling the cargo, all of which are subject to wide variation.

Economy

On the basis of carefully selected test data, supplemented by conservative calculations, it is not difficult to arrive at the relative fuel consumptions of the various types of winch systems. The following figures, therefore, are believed to represent the results of a conservative analysis. The relative proportions, however, are subject to difference of opinion, depending upon the data used in making the analyses. For instance, actual test data are available which show the fuel consumption of reciprocating steam winches to be more than 20 times that of electric winches supplied with power from Diesel driven generators, under practically identical conditions of cargo handling. Other cases show this ratio to be in the order of 12 or 14 to 1.

(a) Electric winches supplied with power from Diesel engine driven generators ..... (1)*
(b) Electric winches supplied with power from geared turbine driven generators (condensing) ..... (3 to 3½)
(c) Reciprocating steam winches ..... (15)**

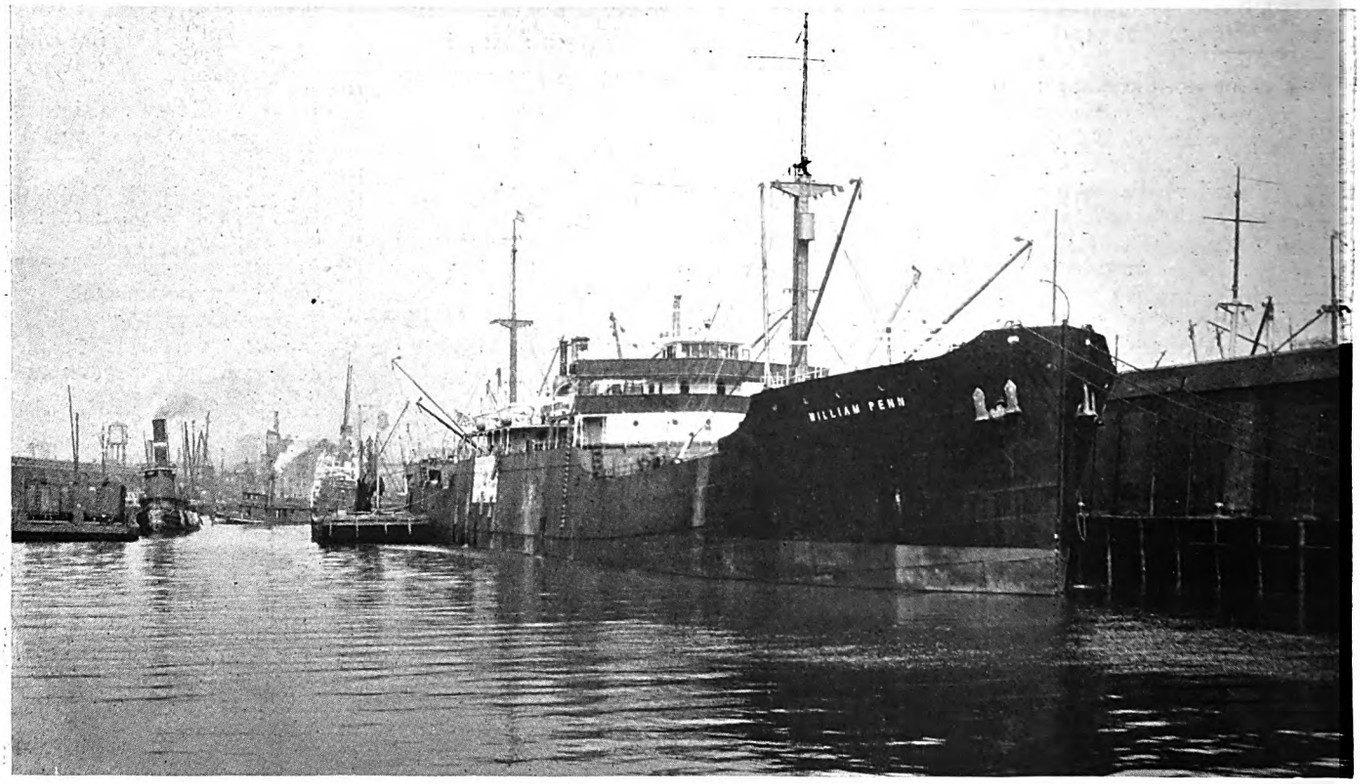
*The fuel consumption for (a) is taken as unity for the sake of convenience.

**By assuming ideal conditions, and calculating the steam consumption for deck winches, results are obtainable showing a consumption of 3½ times that of the electric winches supplied with steam turbine generator power. It has been impossible, however, to locate actual test results anywhere near this figure, all being higher.

Analysis shows that in the case of the ordinary cargo ship, there is a saving equivalent to $15,000 to $25,000 to be had by the use of electric winches, due to the fuel saving alone, not to mention the saving in maintenance, the more expeditious handling of the cargo, and a number of very desirable but intangible advantages. It is only necessary to analyze the facts in any given case to show the advantages resulting from the use of electrical machinery.

Maintenance

Maintenance is a very important consideration and has a proportionate bearing upon the final economical analysis. Here it has been established by practice that the maintenance costs of properly designed and applied electrical machinery have been practically negligible. This condition is as it should be, and as was predicted several years ago. It is true that there are indisputable instances where electrical apparatus on board ship (particularly deck equipment) has necessitated considerable maintenance costs. However, proper examination of these cases shows that the apparatus involved is usually either of insufficient quality, improperly constructed, misapplied, or improperly attended. Deck equipment, in particular, requires a strictly high-grade class of electrical apparatus. There are several electrically equipped ships in service today which carry a very commendable record relative to their electrical auxiliaries, which incidentally are of high quality. It is to the electrical manufacturer's interest, as well as the shipbuilder's and ship operator's interest to insist upon strictly high standard and rugged apparatus. The better the quality, the more profitable is the investment.



Motorship William Penn. The Deck and Engine Room Auxiliaries of this Vessel are All Electrically Operated

Excessive maintenance costs are eliminated by careful selection of electrical equipment, and incidentally this is true of any kind of apparatus. We must not lose sight of the severe requirements imposed by deck winch service. Suitable apparatus can be supplied only after a thorough study and understanding of the problems involved. To obtain the proper results, it is necessary to design the motor, controller and resistor as a unit, and each part of the equipment must function with proper inter-relation, and the combined result

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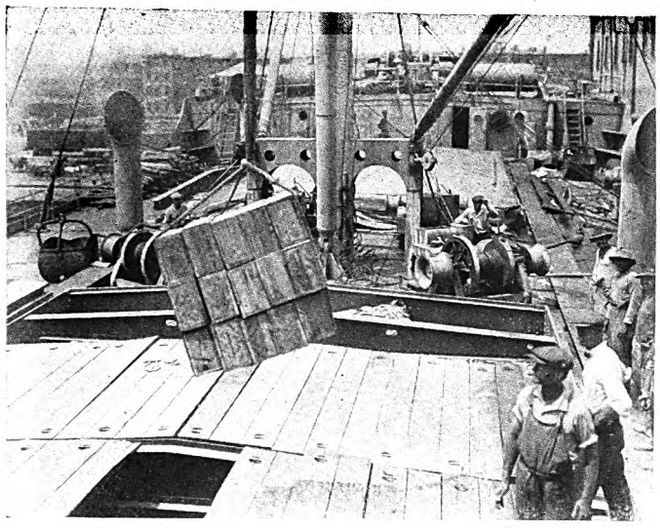
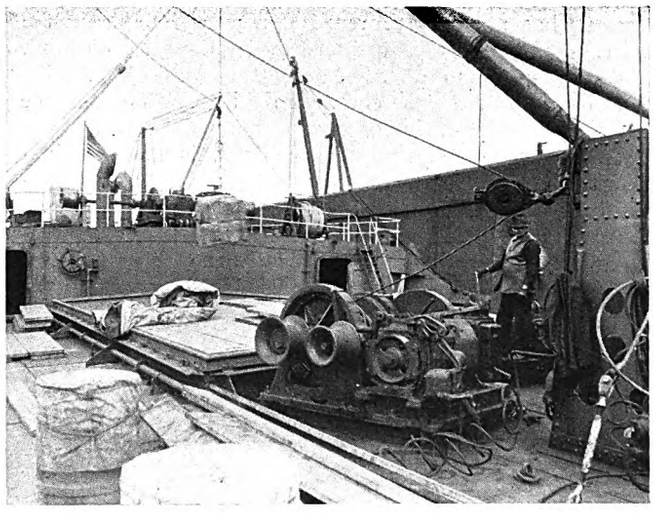


Forward Winches of M. S. William Penn



After Winches of M. S. William Penn

must be that which is required by the most expeditious, most economical and safest handling of the cargo.

Another important factor to be reckoned with in applying deck electrical apparatus is the deleterious effect of sea water. Unless extreme care is given to this consideration in the design and construction, and the apparatus made watertight to prevent the ingress of water when subjected to the wash of solid seas, nothing but trouble can be expected.

These are the reasons why only high-grade apparatus is suitable for the service. The maintenance of electrical equipment so designed and applied is considerably less than that of steam equipment including the steam lines.

Operation and Performance

In regard to the operation and performance, the salient features inherent in the electrical equipment are all that can be desired, and they may be summarized as follows:

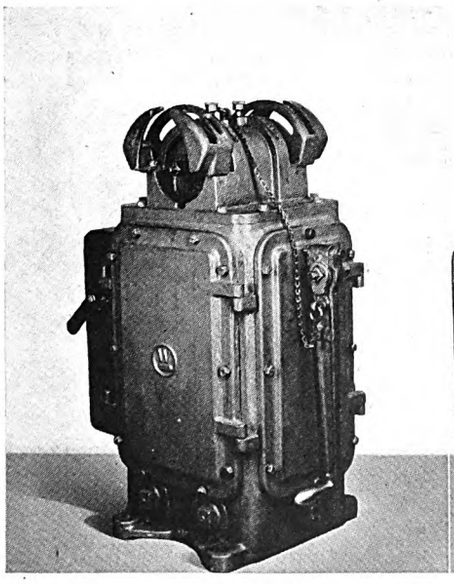
The electrical equipment is capable of ample overload capacity. Its performance is uniform and independent of climatic conditions encountered. It is ready for operation at all times, and requires no preliminary warming up. Its efficiency remains constant throughout its life. It affords any desired degree of control of the loads and is positive in its functioning. Its inherent characteristics are ideally suited to the load requirements in that it handles heavy loads at relatively low speed and light loads at relatively high speeds, and its extreme flexibility enables designs and arrangements to meet any desired condition.

Installation

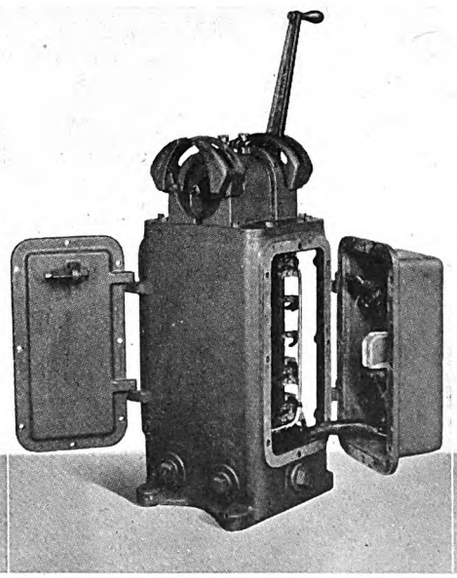
The electrical equipment affords the greatest flexibility and convenience in installation for the reason that its location is not influenced by a desire to place the equipment in proximity to steam pipes or boilers. The cables for transmitting the electrical energy can be installed where most convenient, and their installation made permanent, whereas steam pipes must be installed with the idea of convenience and accessibility for inspection and maintenance. The maintenance of steam pipes is a very serious problem in many installations, while, on the other hand, the maintenance of properly installed cables of suitable quality is nil, barring, of course, mechanical injury.

Reliability

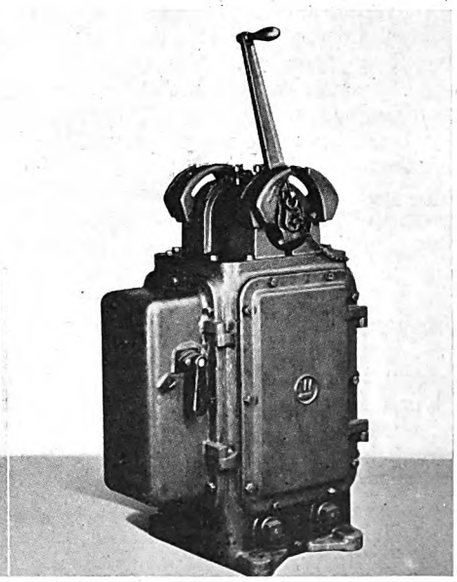
It is doubted whether anyone would question the reliability of electrical apparatus for deck service. Electrical



Deck Winch Controller with Handle Unshipped for Sea



Deck Winch Controller Open for Inspection



Deck Winch Controller in Operating Position

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apparatus has not only proven 100 percent reliable in the hundreds of thousands of cases where it is applied on land, but also the large number of electrical installations on shipboard have proven its entire reliability. The simple rotation of electrical machinery with the consequent absence of wearing surfaces, except the bearings, is the principal reason for its record of reliability. The deck machinery constitutes the most severe application for electrical apparatus on board ship, and to insure its reliability it is merely necessary to build the equipment sufficiently rugged and watertight.

Engine Room Auxiliaries

In the case of motorships, electrically driven engine room auxiliaries are the obvious and natural selection. In the case of steamships, however, there may be some room for argument in regard to the necessity for the improved economy afforded by the electrical system.

It is considered by many that steam auxiliaries are preferable for engine room service because their exhaust steam can be used for feed water heating. Nevertheless, the amount of steam consumed by the engine room auxiliaries, particularly at sea, is tremendous, and amounts to from approximately 20 to 30 percent of the total steam used at sea, depending upon the type and size of ship and propelling machinery. It has been argued that the substitution of electric for steam auxiliaries reduces the available auxiliary exhaust steam to a value below that required for feed water heating, and that for this reason the auxiliaries should be steam driven.

In view of the fact that the energy in the steam can be much more efficiently utilized by resorting to large expansion ratios, it is obvious that as much of the generated steam as is possible could be better used under more favorable conditions, that is, in auxiliary turbine electric units operating condensing while in port, and non-condensing, if necessary, at sea. Should there be insufficient exhaust steam for feedwater heating, it would not be uneconomical to bleed the main engines a sufficient amount to make up the balance required.

Analyses which have been made on this basis show that it is quite possible to make savings of fuel up to 10 and 15 percent in some cases of the total steam generated by the boilers of a ship with the usual steam engine room auxiliaries, not to mention other more intangible savings.

The amount of steam to be saved, or the net reduction in fuel consumption resulting from the electrification of engine room auxiliaries would depend entirely on the kind of ship and proportion of auxiliaries to main units. Economic analysis would have to be made for each particular case or each particular class of ships.

Maintenance

By giving the proper care and inspection to the engine room machinery, its maintenance should be extremely small. One common cause for repairs in the case of engine room electrical machinery is the entrance of salt water into the machines, which results in grounded circuits and improper commutation. However, by suitably protecting the motors, this cause can be eliminated. A drip-proof cover over the top of the apparatus will effectively prevent dropping water from entering the machine, and at the same time will not obscure the vital parts from inspection. In some cases where the motors are located in the bilge, it is desirable to resort to the enclosed, watertight arrangement. As a general rule, it will be found that apparatus which is easily and readily inspected will show the last maintenance.

Operation and Performance

None of the engine room auxiliaries presents any serious problem in motor application. The requirements for the most part call for continuous running, constant duty motors, having simple starters. The flexibility of the electrical system is so great that any desired performance or adjustments can be had readily.

Installation

Here again, the flexibility of the electrical system lends itself to the requirements of practically any installation arrangement, and the motors can be located wherever it is most convenient for the apparatus that they drive. The cables and controlling appliances can be installed wherever desired, and either manual or remote control can be supplied.

Reliability

Here again, the past performance of electrical apparatus is sufficient testimony in behalf of its reliability, and it is a very simple matter to adequately take care of the light requirements of engine room apparatus.

Intangible Advantages

The following is a list of the most important intangible advantages of electric auxiliaries, as compared with steam:

(a) The electric auxiliaries are ready for operation on instant notice, and they eliminate the necessity for keeping steam on steam lines and valves of engines partially cracked so as to be able to operate the engine on short notice, and also to prevent these parts from freezing in cold weather.

(b) Any desired arrangement of control can be obtained with the electrical machinery, and, furthermore the control may be located wherever convenience dictates.

(c) The electrical machinery is considerably quieter in operation, and infinitely cleaner, as the reciprocating noises are eliminated, as also are the leaks from valves and pistons.

(d) In many respects, the electrical equipment is safer from the standpoint of injury to personnel because the voltages used are not sufficiently high to cause danger to life.

(e) From the standpoint of correct application to load requirements, the electrical equipment is far superior to the steam, in that the performance requirements can be very conveniently and accurately studied by the use of electrical instruments, thus placing the engineer in a position to know what he is doing, rather than to guess at his application.

(f) Electrical machinery adds to the living conditions on board ship, by virtue of the elimination of hot steam pipes, which often must be laid in locations where they are most objectionable.

An Economizer That Requires No Outlay

THE installation of economizing equipment in the boiler and engine room entails a first cost that must be balanced against subsequent fuel savings. If the first cost were eliminated, operators would never question the advisability of adopting such equipment. A real source of economy requiring no investment actually does exist in the engine room of every ship, but it is too often overlooked by the staff.

How this economizer can be utilized will be explained in the June issue of MARINE ENGINEERING & SHIPPING AGE

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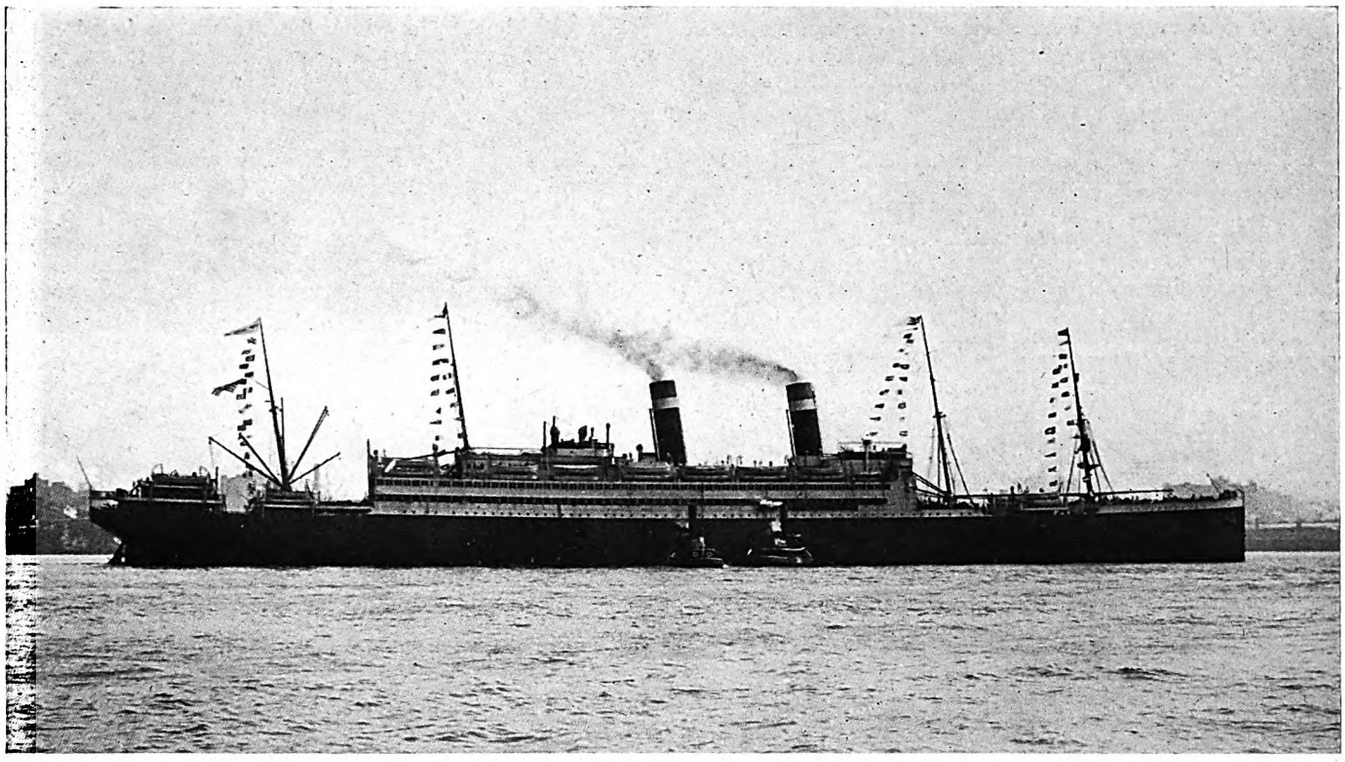

Steamship George Washington, Flagship of the United States Lines

Tuning Up the Engine and Boiler Room

Written on Board the George Washington as a Good Example of What Can Be Done With Existing Ships

By William Bunker*

IN order to keep a ship's propelling unit in an efficient operating condition it is first necessary to have well designed and well built boilers. Although many types have been designed and many more probably will be, the Scotch boiler leads today. There are many well known and competent engineers, however, who believe that a suitable watertube boiler when designed with sufficient steaming space is a better and more efficient unit than the Scotch boiler. This, however, is controversial.

The usual rule of thumb method for designing a Scotch boiler is to allow from 42 to 44 square feet of heating surface to one square foot of grate surface. This, in the opinion and experience of the writer, is erroneous. Some years ago the writer had charge of a vessel operating in the China trade, in which the boilers were originally fitted with 42 square feet of heating to one square foot of grate surface. This was changed by reducing the length of grate bars and constructing special bridge walls, thereby increasing the ratio to nearly 100 to one with the result of over 23 percent saving in fuel. This is a matter of record on which a story may be published in a later issue.

Relative to bridge walls, I think it would be well to mention that the installation of modern ventilated bridge walls has been found to increase the boiler's efficiency. They also eliminate the labor of frequently rebuilding the brick bridge walls.

The present system of fitting tube retarders should be eliminated and the short grate bar fitted instead, getting the benefit of a high initial and a low terminal temperature which we now aim at but do not get with the retarders. Space at present does not permit me to go into the theory of combustion but it is hoped that this matter can be taken up at a future time.

Soot Blowers a Help

One of the modern practices which adds to the efficiency of the boiler plant is the installation of soot blowers, many types of which are excellent and a great many of which are useless. When soot blowers can be fitted to the back ends to blow with the draft they are of considerable advantage but where fitted as front end blowers they have a tendency to back up the products of combustion at the inside or further ends of the tubes and to reduce the efficiency of the boiler by plugging up the tube outlets. This is especially so when tubes are fitted with retarders.

In boilers fitted with the Howden forced draft system it is very often the practice to bank the fires too high when firing, using the upper air check over the furnaces. This is a bad practice. Fires should be carried light and even. Furnaces should be charged at short intervals and the doors closed as quickly as possible after the charging is performed.

Another evil that exists and seems to be inherited from ancient times is the promiscuous use of the slice bar. This tool in a well regulated and well organized fireroom is never used except in cleaning out fires. Of course, common sense

*Superintending engineer, United States Lines.

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ought to teach even the least efficient firemen that they must keep their ash pans clear in order to prevent burning out grate bars and to allow enough air to consume the fuel.

Insulation

All boilers should be thoroughly insulated. The best material for this is an 85 percent magnesia block fitted over a coating of chicken wire which leaves a dead air space. The whole should be covered with plastic cement and either lagged with a sheet iron covering or covered with a modern high class cement such as "Thorkote," which has given excellent results. All pipes should be thoroughly insulated with a magnesia covering. This comes molded in forms up to as large sections as will probably be used in any marine work. These sections should in turn be covered with canvas of double thickness, usually a No. 6, sewed in place. It should be added that all flanges should be covered with a special shaped covering made in halves, made removable in order to remake joints or set up on bolts when necessary.

Boiler water gages should be tested every day at sea and overhauled at intervals of at least once per month.

Boiler Mountings

Surface and bottom blows should be overhauled at stated periods not exceeding 60 days. This also holds good for water column valves, tri-cocks, gage glass fittings, main steam stops, auxiliary steam stops and last, but not least, whistle valve connections. These valves should be taken apart by removing the bonnets, repacking the stems when found necessary, grinding valves in when same are found to seat poorly and putting same in good condition. A great deal of efficiency is lost by leaking valves in a steam plant, a fact that is especially true in marine work.

Fusible plugs are renewed at every yearly boiler inspection and steam gages calibrated at that time. While our steamboat inspection laws are sometimes considered too rigid there are two rules which are certainly correct, one is the installation of fusible plugs and the other is the drilling of staybolts. These screwed stays that are fitted between the combustion chamber and the shell of a boiler or between combustion chambers are drilled with 3/16 inch diameter holes to a distance of ½ inch within the sheet. This is done in order that the breaking of a stay may be discovered by water running out of the hole. One of the ex-German vessels operated by the United States Lines had the German staybolts in her boilers which were of a solid construction drilled to conform to the United States local inspectors' rules and the chief engineer on filling his boiler the first time, found 15 staybolts were broken inside of the shell. This would not have been detected if the bolts had not been drilled. It is believed that in time this law will be enforced in all European countries.

Fireroom, Showing Method of Firing at Sea

Boiler Cleaning

All boilers should be thoroughly cleaned inside and out at regular intervals. The external cleaning, as a matter of

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routine, should be performed at every terminal port; internal cleaning should be performed at dates not exceeding 60 days. The modern ship is usually fitted with air compressor, and the use of pneumatic tools such as valveless scalers, etc., greatly assists the crew in performing this work. The use of compound is still a bone of contention but the engineer who uses clean water, kept slightly alkaline, is on the safe side. This can be determined either by the use of testing kits now supplied at reasonable prices or by reverting back to the old fashioned system of using litmus papers which will tell by turning blue when the water is alkaline. This is a good practice and boilers are perfectly safe when the water is kept clean and slightly alkaline.

Care should be taken to see that all up-takes, breechings and connection doors, etc., are absolutely tight, as leaks here may lead to secondary combustion. This, however, should be followed up by the use of a gas analysis instrument.

Sampling the Flue Gases with Orsat Apparatus

Reciprocating Engines

Throttle valves on main engines should be kept steam tight, free and in good working condition. In reciprocating engines where a governor is fitted, this apparatus should be given periodical inspection and an overhauling at least every six months.

Considerable loss of steam is caused in many engines by the type of piston rings fitted to the high pressure cylinder. This cylinder, on account of taking steam from the boiler direct, is subject to greater heat and pressure than any of the others and special rings should be fitted to take care of this. For cylinders 24 inches in diameter and under a solid plug has been found very efficient. This should be fitted only when cylinder walls are true and they should be made large enough to travel over the counterbore so that when wear takes place another can be fitted and the cylinder walls kept parallel. Above this size, however, it is dangerous to fit the plug type close enough to be economical. The common snap ring does not give satisfaction at the temperatures and pressures now used for marine work of 200 pounds per square inch and over on account of the steam getting behind the ring and forcing same against the walls of the cylinders. This causes the ring to wear and the usual result is a handful of cast iron pebbles or shot lying in the grooves of the piston on arrival in port.

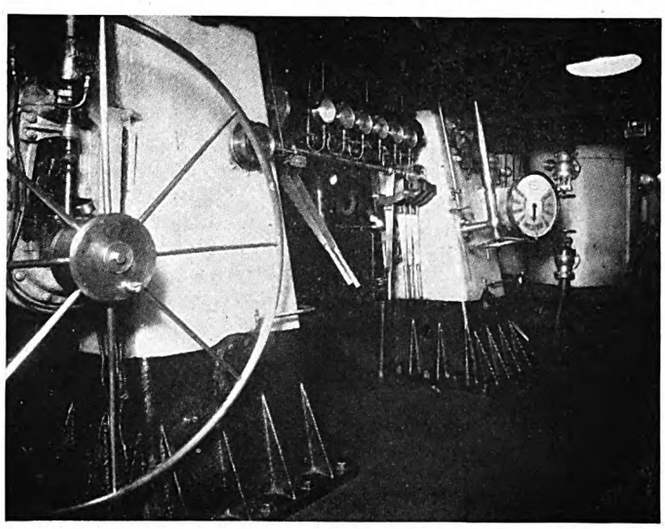
Usually snap rings with a lip left to engage a retaining lip on the bull ring or a heavy single type ring cut to allow for expansion and retained with an internally fitted bolt which can be adjusted to take care of wear is fitted. These rings should have tongue piece fitted to form a continuous joint. The best known ring of this type is called the "Demar" and has been used for many years. Many patent rings are giving good service but it has been decided by practical engineers and men of experience that it is absolutely necessary to retain rings in some manner to avoid damage.

In conjunction with rings it is necessary to have a well fitted piston, which is usually made approximately ½ of 1,000 of an inch per inch of diameter smaller than the diameter of the cylinder. This gives a tolerance of 15/1,000 or approximately 1/64 inch in a 30-inch cylinder.

In cylinders of lower expansions snap rings usually work satisfactorily if made of the correct sections and proper material. It has been found, however, in the case of the low pressure cylinder on condensing engines that due to the pull of the vacuum it is necessary to fit a ring with considerable tension or to fit springs to keep the ring against the walls of the cylinders. Lockwood, Carlyle and rings of this type have proved very satisfactory in low pressure cylinders.

The care and up-keep of the valves in a reciprocating engine means much to the economy of the machine. High pressure valves are usually of the piston type and should be kept as nearly steam tight as possible. It has been found practical to have these renewed when a tolerance of over 6/1,000 takes place due to wear.

The intermediate valves should also be kept tight and the low pressure which is usually a slide valve should be examined at periods not to exceed three months and care should be taken to see that grooves or slots are cut in valve and seat to allow steam to penetrate for the lubrication of the surfaces. These slots or grooves should be kept clean and where relief rings or other means are fitted to the back of the valve to relieve the pressure they



Working Platform. Throttle Valve Is Shown Near Telegraph Dial That Communicates With Bridge. Feed Water Heaters in Background

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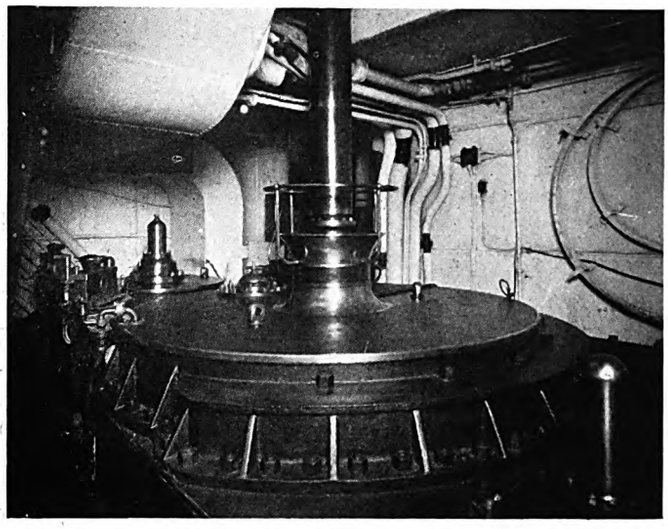
should be kept tight and in a good working condition so that undue pressure will not occur on the valve seats.

The setting of valves is determined by the indicator cards and this should be followed up constantly so that the valves may be kept in a correct position to give a well balanced and efficient engine. Cut-offs should be adjusted to distribute the load equally throughout the different cylinders.

In many vessels, especially those in which forced draft fans are fitted in the engine room, it is found that considerable condensation takes place in the cylinders due to the cold air bath caused by air flowing from skylights. In these instances portable mats should be fitted over cylinder covers to retain the heat as much as possible and reduce radiation.

Packing

Piston rod packing is another very important material that is used in marine engines of the reciprocating type. With saturated steam the ordinary type of packing with pressure



Low Pressure Cylinder, Showing Dome Fitted Over Tail Rod to Avoid Fitting Packing and to Eliminate Oiling. Vacuum Was Increased 1 Inch by This Change

breaker can be fitted if made of a suitable brand of white metal usually with a large percentage of lead on account of the temperature caused by the steam and friction. However, with superheated steam the packing is more of a problem and pressure breakers and wearing rings for the high pressure are made either of cast iron or composition metal, or a combination of both. In the fitting of cast iron the utmost care must be taken as to the composition and texture and the manner in which it is fitted. Unless unusual care is taken in this the result will be scored rods and a failure of the packing. Examination and overhauling should be done at periods not exceeding six months. Care must be used to see that wearing rings float, in other words, work freely against piston rods and that all joints are tight.

The old fashioned system of fitting packing to tail rods has been pretty well eliminated and the latest method is to fit domes over these rods thereby eliminating the use of packing. This method keeps the cylinder covers clean.

On large units, such as the main propelling engines, it is not considered good practice to fit packing with split joints, on packing boxes or gland. One reason is that it is almost impossible to fit a wearing ring to the rod and to the split gland at the same time. There is also the leakage of the joint in the way of the split.

Overhauling Metallic Packing

When dis-assembling packing, care should be taken to see that the wearing rings do not butt on the ends but are allowed approximately 1/32 of an inch clearance to take up for wear and to allow the metal of wearing rings to form a joint by close contact with rod and with the container on which they rest.

In the case of soft packing for auxiliary machinery, where it does not pay or is not feasible to fit metallic packing, care should be taken that a pure asbestos packing is not fitted to a running rod as the asbestos has a very bad effect on steel and will eventually wear grooves in the rod which means renewal in a short length of time. Some good wearing packings contain asbestos but always in conjunction with metal, that takes the wear against the surface of the rod.

Bearings

The fitting of bearings is a matter of routine work and should be laid out on a schedule where all bearings will be taken care of between every 60 and 90 days according to the need for same; this is usually determined by the amount of wearing surface allowed by the design of the engine. A great deal of undue wear is caused by neglecting the cutting of oil grooves and clearances, which is a very important matter and is usually not given attention. The crosshead brasses are usually the first to suffer through this negligence, and the average engineer forgets that his greatest difficulty is to get the oil on the top of the pin and keep it there, which is best done by cutting grooves to keep oil on top of the pin, allowing means for air to escape, and not by running the oil off the top and side of the pin. It is safe to say that the average engineer will reduce the best part of his wearing surfaces 20 percent by cutting improper oil grooves.

When the condition becomes acute and the bearings carry undue heat from this cause the shaft should be raised and either all bearings remetalled or at least those giving trouble should be filled and machined to size and thickness to conform to adjacent bearings.

A bridge gage is usually fitted to each engine and this should be used on main engines at intervals of about six months to determine the wear and alinement of the main crank shaft. The wearing down of the shafts usually does no particular damage other than to cause the shimming up of valves and connecting rods to keep pistons and valves in proper position, unless the wear takes place at certain points. This condition then becomes dangerous due to strain thrown on the crank shaft, bed plates, and reciprocating parts of the engine due to the lack of alinement. When the bridge gage shows undue or uneven wear on main bearings the coupling bolts on crank shaft should be removed and alinement checked by measurement of coupling flange. The proper adjustment of bearings is usually made by allowing a rule of thumb of 1/1,000 of an inch tolerance to 1 inch diameter of shaft over ranges from 2 to 10 inches in diameter. Above this diameter it is usual to allow less clearance, which can be determined better by the action of the engine.

Care of Bearings

Care should be taken in the fitting of main bearings and also of crank pin and crosshead bearings to keep the brasses well up around the journal. A very bad practice that a great many engineers are guilty of is to ease off the sides with the idea of keeping the bearing running cool. This is a fallacy and is not practiced in up-to-date work.

Bearings need a slight clearance on the sides. This is usually arrived at by fitting the parting pieces so that they bear only on the ends and cut away in the center. This space acts as an oil-well and gives all necessary clearance for the carrying of oil, etc.

When arriving at the proper clearance or making adjustments on bearings lead wire is used between the shaft and bearing to ascertain the space between shaft and bearing. Care should be taken to use the proper sized lead, which should be slightly larger than the clearance required for

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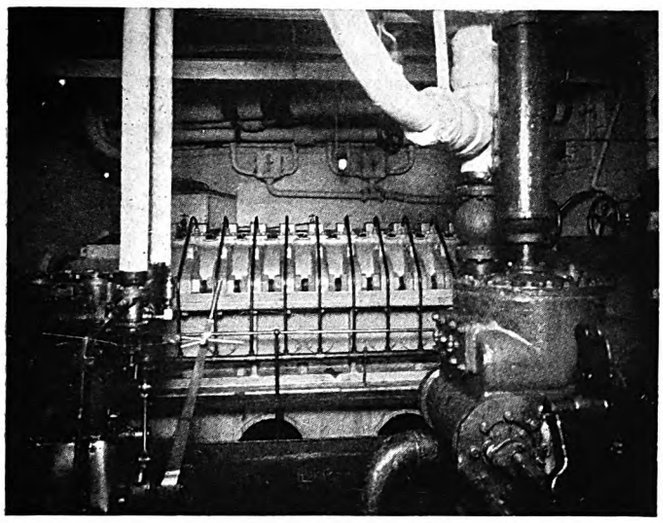
top of bearing. The leads are usually placed about 6 inches apart. When lead wire of too large a diameter is used and when placed closer together than mentioned above a false impression is taken so that when the leads are removed and the bearing put back it very often fits much closer to the shaft than the impression on the leads would indicate.

Where space is available feelers or thickness gages should be used which in the case of crosshead bearings very often



Main Thrust Bearing. Turning Engine Shown at Left and Sanitary Pump at Right

eliminates the necessity of stripping these bearings and using lead wire to get the clearance. The engineer must always watch the adjustment of his bearings, first to see that they are not too tight, which may cause heating and serious damage. He also should see that clearances do not become too great, for this is apt to cause a hammering effect by the journal shaft or pin, resulting in a loss of oil. The metal in the bearings is then apt to crystallize and if engine is allowed to continue for an undue length of time serious results are sure to follow, usually a broken shaft or pin.

THRUST

The thrust bearing fitted to this type of machinery is usually of the horseshoe type. These horseshoes are steel collars filled with white metal and should be kept clean and adjusted both as to tolerance and as to position as wear takes place by the thrust of propeller in driving the ship. Care must be used to keep the shafts set back to compensate for this wear in order to keep the crank shaft in alinement with the cylinders, piston rods, connecting rods, etc. The tolerance of these rings ranges from 4/1,000 to 15/1,000 of an inch according to the size and power of the engine.

The line shaft bearings which perform the function of holding up the shafting between the thrust and propeller shaft usually require little attention other than oiling excepting at intervals of two years when the tail shaft is removed for inspection to conform with rules set down by the classification societies and steamboat inspectors.

When a bearing of this description does cause trouble, usually by losing its white metal, through overheating or undue wear, it is usual to break the couplings on the shafts supported by this and adjacent bearings and then the metal is renewed and the shafts are lined up by comparison with the flange couplings fitted to each shaft.

Tail or propeller shafts are usually made of a high grade steel covered with bronze liners to keep out the sea water. These shafts run on lignum vitæ bearings made by fitting wood of this kind on edge. They are bored to the same or a slightly larger diameter than the shaft, usually allowing 1/16 inch to the foot for clearance, which also allows the sea water to flow in and keep the shaft cool and lubricated while in motion. Many shafts are fitted with patent stern glands intended to hold lubricating oil in the stern tube but few are successful.

CONDENSERS

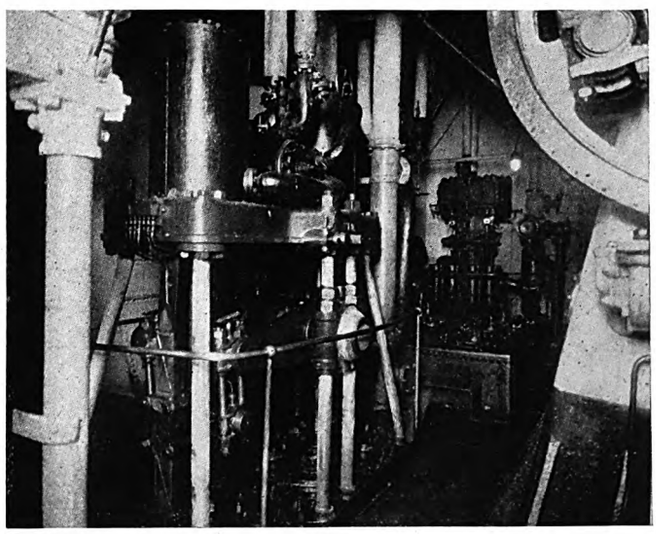
The condenser is usually a vessel constructed with a cast iron shell having a water box of the same material on each end and taking sea water at one end from a centrifugal pump. The water then passes through one-half of the tubes and returns from the opposite end of the condenser through the other half and is then forced overboard. A division plate is constructed to fit between the incoming and out-going water at one end and care should be taken that periodical inspection is made at every terminal port to see that this division plate is tight and in good condition. Many serious accidents to marine engines have been traced through the loss of this division plate at sea.

Fitted over each end between the water box and shell of the condenser there is a heavy brass sheet perforated to receive the condenser tubes. These tubes are usually ¾ inch in diameter (for commercial use) with length to suit the various condensers on the different ships. Holes in the tube sheets are first drilled to a diameter suitable to receive the tubes and then counterbored and threaded to receive packing to make a watertight joint around the tube and keep the sea water from mingling with the condensate.

In early days wooden ferrules were used for the purpose of making tight joints between tubes and sheet but of late years packing of different materials has been fitted around the tubes and compressed and made tight by the use of a ferrule screwed into the threaded gland, forcing the packing against the tube and against the shoulder in the tube sheet to form a water and air tight joint.

AIR PUMPS

After the water is condensed and falls to the bottom of the condenser it is then removed by an air pump and delivered



Air Pump in Foreground, Filter Boxes and Ballast Pump in Background

into the hot well. The air pump is a specially built apparatus which not only removes the water but also creates a vacuum by removing the air from the condenser. It assists the efficiency of the main engine by relieving the atmospheric pressure, which would otherwise operate against the low pressure piston.

(To be continued)

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Oil Burning Affords Great Opportunity for Economy

Secret of Efficient Combustion Lies in Maintaining Proper Adjustment of Oil and Air for Twenty-four Hours of Each Day

By J. S. Milne*

THE keen competition that confronts the shipowner today has decreased the margin of profit and resulted in a demand for increased economies. Fuel is the most expensive item in ship operation and it affords a great opportunity for practical savings.

Many marine engineers think that all they have to do to burn oil efficiently is to turn on the oil and give it sufficient air to prevent heavy smoke. When asked to explain the high consumption, they invariably blame the equipment and are surprised to find that by applying a few of the principles of combustion to general practice, a substantial saving will be effected.

It is not the fault of the engineer for failing to obtain good results if his apparatus is not designed to give all the adjustments necessary for the proper control of air and oil, in order that complete combustion can be obtained with a minimum amount of air.

Complete combustion with a minimum amount of air is the secret of efficient oil burning. It cannot be obtained by judging the appearance of the flame in front of the furnace or the amount or color of the smoke from the stack, but by systematic use of instruments that are designed for determining the results to be obtained. Each fire should be adjusted individually, where it is possible, to give at least 12 percent CO_2 and all the others balanced with the same size tip on each burner and an equal distribution of air so that any variation in power can be obtained by increasing the oil pressure and the air without separate adjustment at each burner.

Importance of Good Atomization

The mechanical burner is the most generally used in marine practice. The oil is heated well above its flash-point and forced under pressure through the burner. The tip and atomizer give it a whirling motion causing the oil to break up into very fine particles entering the furnace in a hollow-shaped spray. The air for combustion is admitted around this hollow cone of oil. On an ordinary job it is seldom necessary or desirable to force air into the fire with sufficient velocity to pierce this cone-shaped spray of oil and still retain sufficient oxygen in the air to support combustion on the inside of this cone of oil. Assuming that it is only necessary to get the air that supports combustion in contact with the outside of the oil film, it will readily be seen how important it is to have good atomization with a real hollow cone and no oil issuing from the center into the furnace parallel to the walls, otherwise a higher air pressure is required with a lowering of efficiency.

The burners are usually designed with air registers, some of which give the air a circular or twisting motion and others a rolling motion. The real purpose is to get the proper amount of air in contact with the particles of oil as quickly and completely as possible, effecting combustion at the front of the furnace, care being taken to cut down the air supply to the minimum. When the job has been properly balanced and all the air adjustments made, it is necessary to maintain this condition continuously while operating. Steam requirements often vary, especially on passenger vessels, requiring the burning of more oil or the lowering of the pressure to suit different conditions of weather and requirements, thereby upsetting all of the adjustments. Under these varying conditions, the use of accurate recording instruments helps the engineer to maintain an efficient system of operation and also keeps the chief engineer in touch with the performance of his juniors, having at all times a record of the condition under which the plant has been operating.

*Chief Engineer, Todd Shipyards Corporation.

Recording Instruments

There are a number of recording instruments for this class of work on the market, the most important of which are as follows:

- CO_2 recorder for stack analysis.
- Recording draft gage for air pressure.
- Recording stack pyrometer for temperature of escaping gases.
- Recording thermometer for temperature of fuel oil as supplied to the burners.
- Recording pressure gage for pressure of fuel oil supplied to burners.

The CO_2 machine is the most important and this should form part of every engineer's equipment as the use of this instrument is becoming more important each day. The recording instruments indicate immediately the changes occurring in operating conditions and permit the engineer to make the proper corrections at once. With this knowledge of conditions so readily obtainable, uncertainty and guesswork are eliminated, and the records obtained are a good check on the combustion performance and should be turned in with the log at the end of each voyage.

We have recently fitted a steamer with apparatus for regulating the amount of air required in accordance with the amount of oil burned on forced draft oil burning installations. The variation in oil pressure is controlled by a very ingenious arrangement for automatically regulating the air pressure, that is, if more steam is required, the governor on the oil pumps is set at a higher pressure. This automatically speeds the blower and keeps the supply of air regulated. This apparatus will effect quite an increase in operating efficiency as it does mechanically what we have been allowing unskilled firemen to do. However, it requires careful adjustment at the start and an interest on the part of the engineer force in its automatic operation.

Summarized, economy in oil burning necessitates the proper adjustment of the oil and air in order that the results can be as near to perfect combustion as possible and this condition should be maintained for 24 hours each day.

The economies resulting from the efficient burning of oil, while increasing the profit of the shipowner, must also be considered as an important factor in the conservation of our oil supply.

Shipping Board Wage Scale Adopted.—At a special meeting of the member companies of the American Steamship Owners' Association, held on April 23, it was voted that the official wage for unlicensed personnel in deck and engine departments of the American Steamship Owners' Association, effective at once, be the same as that now in effect on Shipping Board vessels, and that members be urged to subscribe to this wage and absolutely live up to it until same is changed by action of the Association in conference with accredited representatives of the Shipping Board.

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Meeting Competition by Using Superheated Steam

Operating Efficiencies and Costs of Superheated Vessels Compared with Those Using Dry Steam or Diesel Engine Drive

By Henry B. Oatley*

"I HAVE been shipmates with *saturated* steam for twenty years and see no reason why I should use superheated steam in our ships now." This statement was recently made to the writer by an official connected with a large steamship line operating under the American flag. Much can be read between the words quoted and much more can be said as to the effect upon our merchant marine of backward-looking attitudes of this nature, particularly in this day of high fuel and operating costs.

Competition will always be with us. If it is not offered by ships under other flags, it will be offered by ships under the American flag. When our competitors advance, we must advance further. If they save fuel, we must save more. If they decrease operating costs, we must lower ours an even greater amount.

Comparative operating records and trials indicate that increasing the superheat will increase the efficiency and give added fuel economy.

An increase of 50 degrees in superheat will give the same economy as an additional one-half inch in vacuum.

An increase of 50 degrees in superheat will give greater economy than an additional fifty pounds in boiler pressure.

Increasing the degree of superheat is far less expensive than providing for increased vacuum or increased boiler pressures.

In ship design and construction there are many factors which contribute to success or failure in the operation of that vessel. Many of the errors which may have crept in cannot be corrected except at prohibitive costs. This condition might be the result of errors in design of hull, which affect either speed, stability, or costs of handling cargo in or out of the ship. Many of these handicaps are capable of being removed at relatively small cost and can be made the means of turning losses into profit. Conditions of this kind are frequently to be found in the construction of boiler room or engine room equipment, methods for handling or burning fuel, and in the efficiency with which the energy in fuel is transformed into propulsive effect.

In this range of conditions the use of superheated steam stands out prominently. The contrast in thermal efficiency between saturated and superheated steam operation is well and favorably known. In all fields where steam-driven prime movers are utilized, superheated steam has become of widespread use, but it is remarkable that in marine service its general adoption has lagged somewhat behind railway and industrial power plant applications. During the last ten years, however, marine engineers have turned to superheated steam in increasing numbers as one very effective means of reducing fuel costs and thereby increasing net operating income.

Our American ships are, to a large extent, still operating inefficiently with saturated steam. It is true that during the war the Shipping Board Emergency Fleet Corporation gave some rather indefinite attention to the use of moderate degrees of superheat, but unfortunately the position of the board in this matter was hardly abreast of the development reached by other nations with large merchant fleets. The large proportion of our ships which had been specified to use moderate degrees of superheat were, under the stress of war-time operation, operated with steam little more than dry.

Need for Improvement in Boiler Efficiency

Whatever may have been the reasons and the necessity for this, it is clear that we now must reconsider the situation and adopt all means that have been found effective in reducing the annual expense of ship operation, and which contribute to more revenue-paying ton-miles per year per dollar of operating cost. The time has now arrived when prejudice and old-time views must be brought out, placed on the table and again analyzed in the light of present-day practice.

The arguments for and against the use of superheated steam have been so frequently discussed at much length in the engineering press that it is not considered necessary to again bring them into this article.

Results to Be Gained from Using Superheat

The results, in economy of operation, perhaps have been given less prominence, and it is felt that reference to this "sine qua non" of the question should be gone into in some detail.

What has prompted large and well-managed steamship companies, such as the Cunard, White Star, Ellerman and others in England; the Compagnie General and Mesagiares Maritime in France; the Nippon Yusen Kaisha in Japan and the Luckenbach, Ore Steamship Company and others in the United States, to install superheaters? It surely is not because owners desire to spend more money on their ships or to make any addition to already well-filled engine or boiler rooms. It is not because they are desirous of experimenting, nor is it because their passenger vessels can be advertised as providing additional comfort for passengers. It is because they have found from their own experience, which checked the results obtained by competing lines, that there were advantages represented by decreased fuel cost, increased revenue-paying cargo and, in many instances, because less space was occupied by the boilers to obtain the required capacity and because when coal is used as fuel there is a reduction in fireroom labor, with a consequent preference on the part of fireroom personnel for ships using superheated steam.

A list of all notable examples of vessels, wherein part or all of these advantages have been demonstrated, would read like a page from the Register of the American Bureau of Shipping. The *Homeric, Scythia, Carmania, Tyrrhenia, Empress of Asia,* and *Columbia,* among passenger ships; the *Bolton Castle, Kandahar, Adrar Baoule, Eclipse* (and other

*Vice-president, The Superheater Company, New York.

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vessels of her class) the *Chilore* and *Marore,* and many other cargo vessels on the deep seas; also many hundreds of boats operating on lakes, rivers and canals could be named, all of which are using steam superheated above 500 degrees F. Most of the 3,000 vessels fitted with superheaters, not including our war-built merchant marine, use steam at 600 degrees or upwards.

Executives of steamship companies upon whom the responsibility for operating results may rest, are not so much interested in the number of ships equipped with superheaters as they are in the results obtained. They are interested only in whether or not they may be assured of:

1. Continuity of service.
2. Freedom from additional risk at sea.
3. Reduction in operating costs.
4. Cost of maintenance.

Features of Superheated Service

Continuity of service is in no way jeopardized by the use of superheated steam, when apparatus of a proper design is fitted under proper supervision and operated with the same care and attention given to other equipment in the engine or fireroom. Like every other appliance aboard ship there have been instances of proper design installed under improper conditions, or of improperly designed apparatus, which have not given the full measure of satisfactory service. The widespread use of superheated steam in marine and other service should reassure the timid, or hesitant, executive, that suitable equipment is available and that the expected results can be obtained.

Freedom from additional risk at sea never has been seriously questioned, although it sometimes is referred to as "requiring proof." Many vessels on their maiden voyages have encircled the globe without a moment's delay, or a penny spent on repairs, and without a trace of any indication that the ship was at any time in danger. Important apparatus aboard a ship has to meet the requirements, and pass the inspection, of one or more official classification societies, or government inspection bureaus.

Reductions in operating costs are of greatest interest and most value when summarized. In Table I are given the total operating costs, showing the reduction by the use of superheated in place of saturated steam. A reciprocating engined vessel utilizing saturated steam has been used as a basis. This vessel was described in Marine Engineering and Shipping Age, March, 1923, page 138, with corrections of what appear to be typographical errors. With the use of 200 degrees of superheat a reduction in total operating expense, inclusive of a 10 percent return on the investment, of $4,045 annually is shown.

TABLE I

	With Saturated Steam	With 200 Degrees F. Superheat
Total capital charge (29 percent)	$70,800	$73,660
Fuel used at sea and in port	95,000	85,240
Lubricating oil and make-up feed water	4,035	3,930*
Wages of crew	37,500	37,500
Subsistance	8,500	8,500
Tonnage dues and port charges	32,350	32,350
Brokerage and management	42,750	43,530
Stevedoring of cargo	119,700	121,880
Total operating expense	$410,635	$406,590

* 5 percent additional allowed for lubricating oil.

If the figure of $412,000 in the reference referred to is correct, the saving would be $5,410 annually. This reduction in operating cost would be obtained for a capital expenditure of not more than $10,000 assuming that it was a superheater installation made in an existing vessel. The investment would be less, if the superheaters were installed when the vessel was built. Surely an annual return of upwards of 45 percent of the investment cannot be lightly disregarded.

In the comparison shown in Table I, no credit is taken for additional revenue-cargo permitted by a reduction in weight of make-up feed water and fuel required. This reduction amounts to 150 tons per voyage. An additional 150 tons of revenue-producing cargo per voyage yields (at $4.50 per ton) an income of $6,815 per year. This, added to the saving in operating cost, will more than repay the cost of superheater installation during the first year.

Comparison of Superheated Steam Vessels and Motorships

The relative operating costs of, and investment in, motor driven and steam driven vessels has been widely discussed in the last few years. One of the most recently published,* and perhaps the most carefully worked out, comparison was contributed by Lawrence B. Chapman, professor of naval architecture, Lehigh University. The analyses were brought down to a basis of the "cargo rate to earn operating expenses and to pay a 10 percent return on the investment." It was shown that under the conditions assumed a Diesel engine driven ship, with steam auxiliaries and a geared turbine job with 100 degrees of superheat would, on a 5,000-mile voyage, be on a par with cargo rates at $4.54 per ton. On a 10,000-mile voyage the Diesel drive would have an advantage over the geared turbine ship.

In the comparison referred to, 100 degrees of superheat was assumed for the turbine ship and only saturated steam for the reciprocating engine drive. Just why both steam driven vessels were placed on such a basis was not made clear. Believing that the hundreds of vessels operating satisfactorily for years with highly superheated steam justifies the assumption that the steam driven vessels in the comparison could be made much more attractive in operating costs, such calculations have been made. The two steamships in the article above mentioned have been figured through, using the same assumptions, general data and formulæ as used by Professor Chapman, but 200 degrees of superheat have been taken.

Using the same formulæ for steam consumption per shaft horsepower or indicated horsepower hour the 100 degrees increase in superheat for the geared turbine vessel results in a 7.4 percent steam saving; while the addition of 200 degrees of superheat on the triple expansion vessel gives a 15.2 percent steam economy.

Boiler efficiency, of course, is improved because of the increased amount of heat-absorbing surface, which causes a reduction in the waste-gas temperature of from 50 degrees to 100 degrees. The boiler efficiency in the turbine-driven vessel will become easily 72 percent instead of the 70 percent assumed by Professor Chapman. In the triple expansion engine job, where 200 degrees superheat is added, a boiler efficiency of 74 percent instead of 70 percent will be obtained from the Scotch boilers when fitted with firetube superheaters. These efficiencies, when used in the calculations for fuel economy, show 5 percent and 12 percent savings for the turbine vessel and reciprocating engine vessel respectively, and will check closely with the service results obtained from a large number of vessels.

In making the correction for the increased degree of superheat, arriving at the figures given in Table II, allowance has been made for the increase in weight due to the superheaters and for the cost of the superheater application and its installation.

The Higher the Superheat the Higher the Economy

The efficiency ratio used by Chapman will be increased by the increased degree of superheat, because the benefits measured by reduced steam and fuel consumption per horsepower hour exceeds the calculated and theoretical figures based on temperature-entropy analysis. This increase, in

* Marine Engineering and Shipping Age, March, 1923.

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the case of turbine engines, is partly the result of decreased windage losses and, in the case of reciprocating engines, partly the result of decreased valve and piston leakage. The efficiency ratio, therefore, for the turbine powered vessel has been changed from 0.62 to 0.63, and for the triple expansion engined vessel from 0.575 to 0.60.

By making the proper corrections in the items given in Tables I, II and III,* we find that the rate per ton of cargo necessary to give 10 percent return on the investment in addition to direct operating charges will, for the four ships, be as given in Table II.

TABLE II

Type of Propelling Machinery	Superheat, Degrees F.	Rate per Ton of Cargo to Give 10 Percent Return on Investment 5,000-Mile Voyage
Geared turbine	200	$4.50
Diesel (steam auxiliaries)	...	4.54
Triple expansion	200	4.67
Diesel (electric auxiliaries)	...	4.82

The beneficial effects from an economy standpoint by running at low vacuum are well known, and are quite generally appreciated. The advantages of increasing the degree of superheat, however, assuming that low degrees of superheat have been used, are very well established, but are not so generally appreciated. On a number of recent investigations, the purpose of which was to determine the economies in fuel and in operating cost, these factors were analyzed in considerable detail. It was shown, for example, that the same additional economy in daily fuel consumption was obtained from an increase of superheat from 150 degrees to 200 degrees, as was obtained by increasing the vacuum from 27½ inches to 28 inches. Also that to raise the superheat from 100 degrees to 200 degrees resulted in a greater fuel economy than increasing the vacuum from 27½ inches to 28½ inches. The difficulty in constantly maintaining high vacuum is well known and many ships, particularly those operating in tropical waters, lose more than 1 inch of vacuum compared with their operation in the higher latitudes. In these comparisons a boiler pressure of 300 pounds existed. For lower pressures the same *relation* would exist between increased superheat and increased vacuum, although the *percentage economy* in both cases would have been higher.

The thermal advantages and consequent fuel economies with higher pressures also have been well recognized, but the gain from increased degree of superheat in comparison with the gains from the higher boiler pressures have been given less publicity. With a vacuum of 28.5 inches, 250 pounds boiler pressure and 150 degrees of superheat, the comparison shows that by raising the degree of superheat 50 degrees a fuel economy of 1.9 percent is obtained; while by increasing the boiler pressure from 250 to 300 a saving of 1.8 percent in fuel consumption is accomplished. It is admittedly less expensive in the first cost to increase the degree of superheat than it is to provide for higher boiler pressure, but it also is clear that both ways of effecting a reduction in operating cost should be given careful study.

The amount of superheat carried is independent of these conditions, and indicates one reason why continued and uniform economy from the use of the higher degrees of superheat is assured.

KEEPING SUPERHEATERS IN SERVICE

The cost of maintenance is difficult to state in definite terms, unless there be a very full description of the conditions existing. These conditions vary with the class of ship, character of service, ports touched, fuel used and last, but not least, personnel of the ship and policy followed by the steamship company as to maintenance and repairs.

Maintenance cost due to the use of superheated steam is as variable as repairs to other boiler and engine-room equipment. Information obtained from the owners of ships operating with high degrees of superheat shows that maintenance costs are not increased on the basis of total investment due to the use of highly superheated steam. A figure of 6 percent on the investment in the equipment will very fairly cover the annual repair, maintenance and overhauling due to the use of highly superheated steam. The maintenance cost included in Table I has been increased $600 for the use of the superheaters. This is considered high when these costs taken from the records of many ships over a period of years are known.

In conclusion, it does not seem that the owners of American ships, faced as they are today with the necessity of scrutinizing operating conditions which include not only higher wages, but the very unstable condition of purchasing or building of vessels, can afford to disregard the advantages of all factors which are successfully utilized by their competitors operating ships under other flags.

The Diesel, in comparison with steam engine, is receiving very careful study, and the operating results of such ships will be a matter of vital importance. There is, however, ample evidence to support the contention that the steam-driven vessel—admittedly capable of very great improvement—is superior under many operating conditions to a ship propelled by internal combustion engines, and in this contention the further improvement of the Diesel or semi-Diesel engine is not disregarded. The geared turbine or the turbo-electric-driven ship with high degrees of superheat, and with higher boiler pressures, has proven, in the recent past, and without much doubt will continue to demonstrate, its advantages for the powering of our ships.

*MARINE ENGINEERING AND SHIPPING AGE, March 23, 1923, pages 138 and 139.

Plaintiff's Rights in Limitation Suits

WHERE the plaintiff in a limitation suit has settled claims abroad, arising out of a collision in respect of which the decree of limitation has been obtained, he is entitled to bring payment of such claim into consideration before the registrar when the administration of the limitation fund is decided upon. Proof of such payment may be brought before the registrar notwithstanding that such payment was made under a foreign system of limitation, or for an amount not limited according to the English rule of limitation. It is not material that the claimants to whom such payment was made were not subject to the jurisdiction of the Court.

The steamer *Dokka* and her cargo were sunk in collision with the steamer *Coaster*. After the collision the *Coaster* put into a French port, where her owners were forced to give bail in order to secure her immunity from arrest at the suit of the owners of the *Dokka*. Bail was given in an amount equal to the value of the *Coaster* at that time, which was the full amount of the liability of her owners under the law of France. In subsequent proceedings in France the *Coaster* was held alone to blame, and her owners were condemned in the amount of their bail and costs. The owners of the *Coaster* discharged the judgment debt and then commenced proceedings to limit their liability in England. A decree of limitation was pronounced and at the subsequent reference a claim was filed by the owners of the cargo laden on the *Dokka* and the owners of the *Coaster* themselves also filed a claim for the amount they had paid under the judgment in France, together with their costs in the French proceedings. The registrar allowed their claim for the amount paid to the owners of the *Dokka*, i. e., the amount of the statutory liability of the owners of the *Coaster* in France. The English Supreme Court of Indicature in Admiralty held that the claim was properly allowed. Aspinall's Maritime Law Cases. Vol. XV, Part VII, page 560.

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How to Buy Fuel of Proper Quality at Lowest Price

By Major George M. Talbot*

IN the present era of low freight rates and high operating expenses the fuel bill, which usually represents from thirty to forty percent of the actual operating expenses in steamship operation, should be given first consideration in order to reduce its cost to the absolute minimum consistent with efficient operation of the vessel under consideration.

The most important problem is to procure fuel of a proper quality at all times at the lowest possible price.

Study the market conditions carefully and *buy right.*

Buy on a *long term contract* and avoid the market fluctuations.

Be *sure* the *quantity* and *quality* of fuel you buy are *actually* delivered.

Keep your "burning equipment" in *efficient* condition.

Employ only *competent* and *efficient* engineers and firemen.

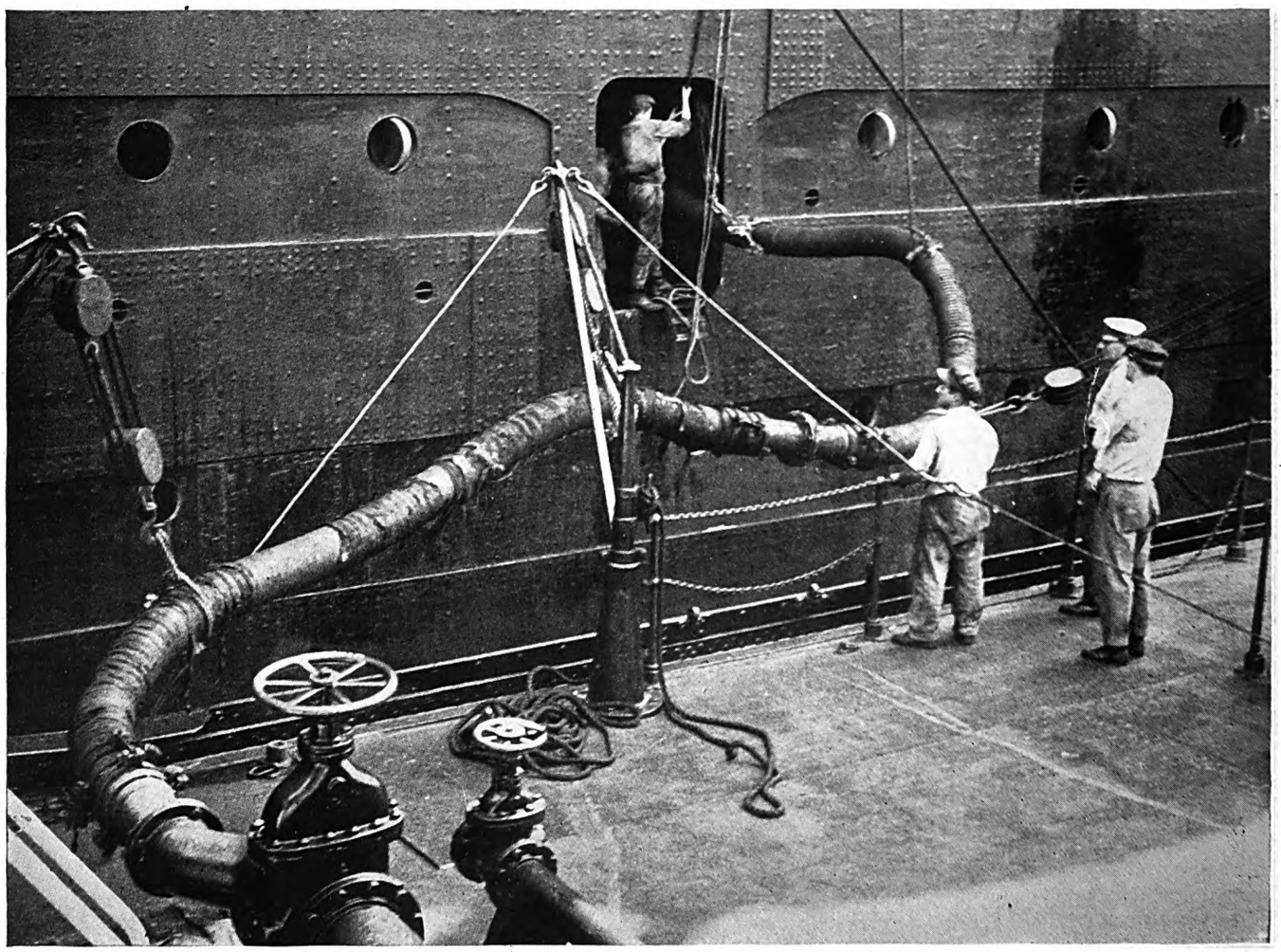
In purchasing coal and oil, the purchaser should carefully study conditions affecting the market value of these commodities and endeavor to contract for requirements when the market value is lowest. While some purchasers of coal and oil prefer to take their chances on the open market or make short term contracts, the writer prefers the long term contract covering one year or longer. By making a long term contract with a reliable supplier, who can guarantee performance, the purchaser will usually avoid the market fluctuations. He is thus enabled to undertake long time freighting contracts and know in advance what the largest single item of his operating cost will be.

*Assistant manager, fuel department, United States Shipping Board Emergency Fleet Corporation, Washington, D. C., and member of Fuel Conservation Committee.

Fuel Oil

The question of quality is an important one. In purchasing fuel oil the purchaser should consider using the lowest grade of fuel oil that his burners can handle efficiently, bearing in mind that if he demands too high a grade of fuel oil the refiner is compelled to leave some of the more valuable by-products of crude petroleum in the fuel oil, and, therefore, must obtain a higher price for this commodity.

A grade of fuel oil that the majority of vessels can handle



S. S. Aquitania Taking On 55,000 Barrels of Fuel Oil in 9½ Hours

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efficiently, if the vessels' bunker tanks are equipped with facilities for heating the oil, is commercially known as bunker oil "C." This grade of fuel oil is considered the most economical fuel on the market today.

In producing this grade of oil the refiner is able to extract from the crude petroleum the lighter and more valuable fractions, leaving a residuum oil that is entirely satisfactory for use as fuel. The calorific value of the residuum usually runs about 2.5 percent less than the crude from which it is extracted.

Points to Specify

As a guide to the purchaser in preparing his specifications the following are the most essential points to cover in order to be assured of a proper quality of oil:

Flash Point. In order to comply with insurance regulations and minimize the fire hazards, it should not be lower than 150 degrees Fahrenheit, test to be made in a closed tester.

Water and Bottom Sediment. Water and bottom sediment in the oil should not exceed two percent.

Viscosity. The viscosity should not exceed 300 seconds at 122 degrees Fahrenheit, test to be made in the Saybolt Furol, Viscosimeter or equivalent results if test is made on other instruments.

It is not necessary to specify the number of British thermal units to the pound of fuel oil, for the reason that the fuel oils supplied by the principal oil companies throughout the world seldom vary more than five percent in British thermal unit value. This, however, is not the case with bunker coal whose British thermal unit value varies in different localities as much as twenty percent.

Viscosity Specification More Accurate

Although it has been the custom in the past to specify an oil of a certain specific or Beaume gravity in order to determine one of the principal characteristics of the oil, i.e., its fluidity, a gravity specification does not determine this feature with sufficient accuracy, and, therefore a viscosity specification has been substituted which more accurately represents the nature of the oil.

A great many are of the belief that viscosity and gravity are closely related. This is not the case as evidenced by the following definitions of these terms:

Viscosity is a measure to determine the fluidity of a liquid, its internal friction or its resistance to flow.

Specific gravity as applied to liquids is the method used to determine the weight of a liquid and is defined as the ratio of the weight of a given volume of a liquid to the weight of an equal volume of fresh water.

Beaume gravity is another method consisting of the use of a hydrometer to determine the weight of a liquid.

As a further indication that these two terms are not closely related, it has been found that it is possible for a 16-degree Beaume fuel oil extracted from a naphthene base crude oil to have a greater viscosity and, therefore, to be more difficult for pumps to handle at a temperature of 100 degrees Fahrenheit than a fuel oil of 13-degree Beaume at the same temperature, which was extracted from a paraffin, or mixed base crude oil.

Notwithstanding these facts which should be apparent to any student of the subject, some purchasers of oil still insist on a higher gravity specification when what they really seek is a lower viscosity.

Bunker Coal

In purchasing bunker coal, some follow the custom of purchasing under a trade name or under a recognized classification, others purchase under an analysis specification, while still others make the mistake of purchasing almost any kind of coal that can be procured at the lowest price. There is no doubt but what it is more economical to purchase the highest grade of coal that can be procured, provided there is not too great a price differential.

The writer will not attempt to establish anything that might be considered as a proper price differential in the different grades of coal, but I think that it is reasonable to assume that, if one coal is five percent higher in ash and fifteen percent lower in British thermal units than another coal with approximately the same percentage of volatile, fixed carbon and sulphur, it is twenty percent less efficient and, therefore, worthy twenty percent less.

Wherever it is possible to procure what is commercially known as a high grade semi-bituminous coal and practicable to purchase under an analysis specification, I consider this method most desirable.

Analysis of Good Bunker Coal

Coals of the following approximate analysis should be considered good coals for marine use:

Volatile not over 24 percent.

Fixed carbon not less than 66.5 percent.

Ash not over 8 percent.

Sulphur not over 1.5 percent.

British thermal units, dry coal, not less than 14,500.

In some localities coals can be procured that will produce a better analysis than the above, while in other localities the best coal obtainable will not equal the above analysis.

Conclusions

In summarizing the above, the following are the most important features that should be given the closest possible supervision in order to reduce the fuel cost to the absolute minimum:

1. Study the market conditions carefully and buy right.
2. Be absolutely assured that the quantity and quality of fuel that you purchase is actually delivered to your vessel.
3. Keep vessels' "burning equipment" in proper repair to efficiently burn the fuel.
4. Obtain from vessels' personnel the highest possible efficiency in handling and burning fuel aboard the vessels.

BULLETIN No. 126, entitled "An Investigation of the Fatigue of Metals, Series of 1922," is the second report to be issued on the investigation of this subject by the University of Illinois. Copies may be obtained without charge by addressing the Engineering Experiment Station, Urbana, Illinois.

Does it Pay to Have a Satisfied Crew?

CAPTAIN JOHN F. MILLIKEN, secretary of the Neptune Association, states in a feature article which will appear in the June issue of MARINE ENGINEERING AND SHIPPING AGE, that "sooner or later our shipping men will discover that the cheapest men are not always the most economical and that a satisfied crew pays real dividends."

One suggestion he offers to attract men to the service and to make the operating problems their own is to encourage them to purchase a few shares of stock. As stockholders in a company these men will take a personal interest in the success of the fleet.

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Designing the Marine Power Plant for Efficiency

Analysis of Factors Affecting the Economy of Various Types of Main Drive, Auxiliary Equipment and Economizers, with Practical Examples

By Warren B. Flanders*

THAT greater efficiency in the operation of steamships under the American flag is not only needed, but will be obtained, is evidenced from the great increase in attention being paid to this subject. This is evidenced not only by the operating management, who take a keen interest in the subject from the dollars and cents point of view, but by the engineering personnel as a matter of professional interest.

Of recent years there has been great progress in the development of the steam turbine and its use for ship propelling machinery. This development has progressed along the lines of the direct-connected turbine (for use with the higher speed vessels only), the single reduction geared turbine, the double reduction geared turbine and the use of generators and motors between the turbine and propeller. (These three systems are applicable to moderate or low powers as well as high.) In this development there has been a marked advance in economy, and numerous reports have established the relative efficiencies of these types of equipment. The following table, therefore, might be taken as a fair statement of the relative performances in the way of steam consumption of the different types for the same class of vessel, where superheat is not employed.

TABLE 1

Type of Propulsion	Steam Consumption per Shaft Horsepower Hour—Main Engines	Relative Consumption Percent
Triple expansion	15.0	128
Direct connected turbines*	13.0	111
Single reduction geared turbine	12.7	109
Electric drive	12.2	104
Double reduction geared turbines	11.7	100

*Used for large powers only.

On the basis of the same conditions of steam pressure and quality of steam, this comparison indicates the progress that has been made in better economy in the engine room and, of course, reduction in steam consumption means a similar reduction in fuel consumption with a net saving to the operators of the percentage indicated.

Savings Possible With Superheaters

Further savings have been effected by the use of superheaters, and undoubtedly great progress is being made in this direction, the high speed gear or electric drive turbines making possible the utilization of high superheats with safety. Thus, with 100 degrees superheat, the steam consumption of the engine room may be reduced 10 percent and, as the same, or even slightly higher boiler efficiency may be obtained with this amount of superheat, the fuel consumption will be decreased 5 to 6 percent. With higher superheats, further gains may be expected, and there is a tendency to use even as high as 200 to 250 degrees superheat in certain cases. This, however, means a total steam temperature of from 600 to 700 degrees F., and entails special attention in the way of design of piping, valves and miscellaneous equipment, especially pumps and other auxiliaries.

It is usual to indicate savings due to superheat as based on the use of dry and saturated steam and as savings in steam consumption. The matter of real interest is the net savings to be expected in *fuel* over the use of steam as normally delivered by the boilers. Fig. 1 has been prepared therefore, showing this saving based on the use of steam with a quality of 98 percent. The saving in steam consumption has been corrected for the additional heat required to superheat the steam and a constant boiler efficiency is assumed.

Some authorities claim 50 degrees of superheat may be obtained by waste heat superheaters with no increase of fuel consumption, in which case the curve would be as indicated by the dotted line.

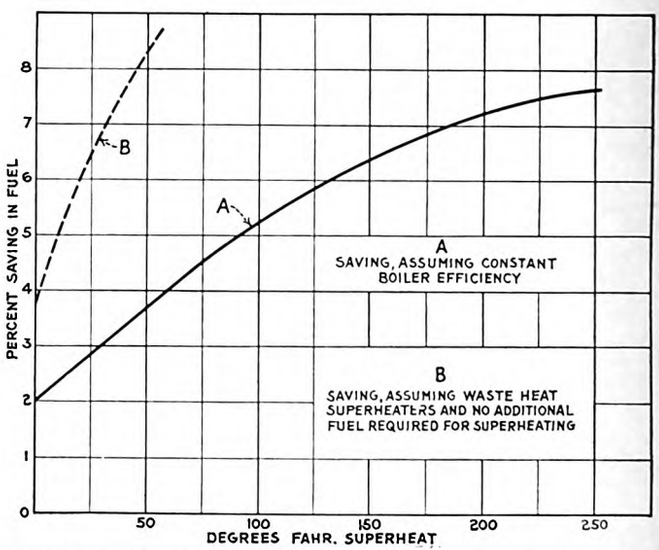

Fig. 1.—Saving in Fuel Consumption by Use of Superheat Based on Steam at 200 Pounds Gage Pressure, 98 Percent Quality, and Vacuum 28½ Inches in the Exhaust

Higher Boiler Pressures Economical

Increased attention is being paid to the use of higher steam pressures combined with higher steam temperatures in the form of superheat, and it is not improbable that in a very few years a steam plant operating with 600 pounds pressure and 200 degrees superheat will be not uncommon. There are many problems, of course, to be worked out in connection with this progress, and these center largely around the selection of the auxiliary equipment on the ship and the methods of feedwater heating. The question of design of boilers, piping and main turbines may be said to be practically solved and it only awaits someone with sufficient initiative to go ahead with the carrying out of an actual installation.

By the use of 500 or 600 pounds steam pressure at a temperature of 600 to 700 degrees F., together with a suitable arrangement of auxiliaries, with particular attention paid to the heating of the feedwater, involving possibly the use

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of economizers and air heaters, a fuel consumption for a 3,000 shaft horsepower vessel of 0.6 pound of oil per shaft horsepower is not an impossibility.

It is obviously necessary in order to attain such a performance that everything entering into the equipment be of the highest quality; that the ship be maintained in the best possible condition and the operating personnel be of the highest order of intelligence and ability, combined with a willingness to keep everlastingly at the details of operation. These are just the elements which may be expected in the American merchant marine, so there would seem to be no great obstacle in the way of this attainment.

FURTHER ECONOMIES IN THE BOILER ROOM POSSIBLE

There still seems to be a great deal of room for improvement in the economical operation of the average ship, and the greatest field in this direction is undoubtedly in the boiler room. C. J. Jefferson, in a paper recently read before the American Society of Mechanical Engineers, pointed out the possibility in this direction. Boiler plants, which average in service from 60 to 65 percent efficiency, as determined by actual investigation of many ships, are shown to be capable of operating with 80 percent efficiency or better, by merely paying proper attention to the firing conditions and in the maintenance of the boiler equipment in satisfactory condition. This item alone shows a possibility of saving 20 percent of the fuel used on the average vessel. Recent trials with a 1,500-horsepower equipment having oil-fired watertube boilers, made under actual sea conditions, show a similar saving possibility. An average consumption of oil a day of 20 tons for a large number of sister ships was reduced to 16 tons for a single ship when operated under a careful supervision, directed especially towards the economical burning of the oil.

WASTE ELIMINATION IN AUXILIARY UNITS

Next to the boiler room, the most fruitful field for improvement in economical performance is in connection with the feedwater heating system and the selection and operation of the auxiliaries. In an older type of engine drive, many of the principal auxiliaries were driven directly from the main engine, and this, combined with a moderate degree of feedwater heating, led to a degree of economy which offset some of the advantages to be obtained from the geared turbine installation. With the rapid development of this latter form of drive, the auxiliaries were largely separated from the main engines and little attention was paid, in many cases, to their economical operation. Comparatively wasteful direct connected turbines, or even reciprocating engines were used for driving circulating pumps, etc., with the result that the overall economy was in many cases disappointing.

The auxiliaries are necessary to the operation of the main machinery and the ship and may be classed as "Engine Room" and "Miscellaneous."

The engine room auxiliaries may be taken as:

Boiler feed pumps.
Boiler fuel oil pumps.
Boiler blowers or fans.
Condenser circulating pumps.
Condenser air removal apparatus.
Condenser condensate pumps.
Turbine lubricating oil pumps.

The miscellaneous auxiliaries may be listed as:

Ship lighting and power sets.
Ballast pump.
Fire and bilge pumps.
Sanitary pumps.
Refrigerating machinery, etc.

The total number of steam driven pumps and blowers of a large passenger vessel recently described, reaching the number of fifty, varying all the way from a 4½-inch by 2¾-inch by 4-inch horizontal hot water circulating pump, to the two 10,000 gallons per minute main circulating pumps.

THE HEAT BALANCE SHEET

A study of this equipment naturally brings up the subject of heat balance and plant economy.* Heat balance in engineering language at one time meant but one thing. It was a balance sheet, just like a financial balance sheet, in which the British thermal units in the fuel are balanced against the total British thermal units expended. Such a balance sheet is shown in Mr. Jefferson's paper above referred to, of which the following is an example:

Heat absorbed by boiler and superheater, percent	84.6
Loss due to burning hydrogen in fuel, percent	6.0
Loss due to heat carried away due to dry gas, percent	3.8
Loss due to carbon monoxide, percent	.2
Loss in unconsumed oil and unaccounted for, percent	5.4
Heat in fuel as fired, percent	100.0

This shows the heat balance for the boiler room, and as far as this particular department is concerned, 84.6 percent of the heat in the fuel is delivered to the steam ready for use in the engine room.

Another heat balance of the same kind may then be made up for the engine room and this will show:

Heat turned into useful work on the propeller shaft, percent	15.4
Heat used in auxiliary power, percent	1.5
Radiation and leakage, percent	2.8
Heat rejected to sea water in condenser, percent	64.7
Total heat received from boiler room, percent	84.4

The above balance sheets are for an economical plant in which power would be produced for 0.91 pound of oil per shaft horsepower.

The term "heat balance" is now taken to also cover the preservation of a proper balance between the feedwater heating requirements and the amount of steam available from the auxiliary machinery for efficient feed heating.

When the large percentage of heat rejected to the sea water is considered, it is obvious that every attempt must be made to keep this amount low, and wherever possible, steam should be so used that any heat remaining therein after doing work, may go back to the boiler through the means of the feedwater, rather than be discharged to the condenser, where it is irrevocably lost. This form of heat balance deals directly with the choice of auxiliaries and their drives, such that the steam used by them, either directly or indirectly, will balance the feed and other heating requirements in so far as this can be done. The reliability of the auxiliaries is of primary importance and has a deciding influence on the choice.

ARRANGEMENT OF AUXILIARIES

There are many arrangements of auxiliaries and methods of drive, all with their different relative reliability and it is the economic phase of this matter that of late years has received very considerable attention on the part of stationary engineers, with the resultant considerable improvement in power plant economies.

The steam having passed through the main turbine and having been condensed, is usually delivered to the feed and filter tank, where it mixes with various drains and in some cases is given some heat from air ejectors or the exhaust from small pumps, etc. From there, it is usual to pass the feed through some form of feedwater heater, into the boiler. A feedwater heater may receive steam direct from the boiler and thus heat the feedwater to the temperature of the boiler steam, or the feed may be pumped into the boiler by

*Much of the material which follows was suggested to the author by Mr. Francis Hodgkinson, chief engineer, South Philadelphia Works, Westinghouse Electric & Manufacturing Company.

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means of an ejector, the steam used in which heats the water directly with no loss of heat units. With the feed and the boiler alone considered, this operation is carried out at 100 percent efficiency, except for radiation. Such installations of heating by boiler steam have been actually made for the purpose of avoiding varying temperatures and consequent strains in the boiler. A case of this kind is reported in the harbor tug *Dresden* in Boston.

Engine Exhaust Used for Heating Feedwater

Considering the power plant as a whole, however, steam to be used for heating feed should be allowed do as much useful work as possible, by expanding in an engine (turbine or reciprocating), when, with ordinary efficiencies, power may be produced for some purpose with but a use of 6 to 7 percent of the water heating capacity of the steam. Thus, considering boiler steam as a medium for heating, useful work may first be done and the exhaust used for the heating process, with a very slight loss in the heating capacity. Thus, it is possible, with steam at a pressure of 200 pounds at 98 percent quality, exhausting at 8 pounds back pressure, to produce a horsepower in the auxiliary turbine with 34.5 pounds of steam and assuming that the exhaust steam will give up all its heat at the exhaust pressure, we have the following balance:

Total heat in steam at 200 pounds..1181.9 British thermal units
Total heat in liquid at 8 pounds.... 204.1 British thermal units
Heat available for work or heating.. 977.8 British thermal units
Heat used in doing work 2,545÷34.4= 74.0 British thermal units
(2,545=British thermal units per horsepower)
Heat available for heating..... 903.8 British thermal units
Efficiency of work process 903.8÷977.8=0.925

Economical Land Installations

The majority of economical land power plants are used for generating electricity and the main operating machinery runs at practically constant speed, and the electrical energy is generated at constant voltage. It has, therefore, been the rule in such plants to drive some of the auxiliaries directly by steam and some by electric motors. This permitted numerous arangements for feedwater heating by means of steam which had done some work. Among these methods may be cited the following:

A. Steam drive is used for such auxiliaries so that the exhaust steam condensed in a feedwater heater will give the feedwater temperature corresponding to the exhaust temperature of the auxiliaries, at the average operating condition of the main power unit, the balance of the auxiliaries being motor drive.

B. The same general arrangement as "A" is followed, except that the auxiliary units are selected so as to give the maximum feedwater temperature at the full load of the main unit, and automatic means are provided for admitting the excess auxiliary exhaust steam into a suitable stage of the main power unit when this unit is operating at the lighter loads, when there will obviously be more auxiliary exhaust than can be used for heating the feed.

C. The same arrangement as "A" is employed but with the addition of an automatic valve, which at light load on the main unit, permits the excess auxiliary exhaust steam to be admitted to the main unit, as in the case "B," and of a second valve, which at times of heavier than average loads, admits steam from a higher pressure stage in the main unit to make up the deficiency in exhaust from the auxiliary unit.

D. All auxiliaries are driven direct from the main unit, usually through the use of electric motors taking power from the main turbine driven generator. The feed heating is accomplished by bleeding the turbine of the steam which can be condensed in the feedwater heater.

E. A power unit is installed in addition to the main unit, this power or auxiliary unit operating a generator independently of the main turbines, and all of the auxiliaries are operated by means of motors from this auxiliary generating unit. The exhaust of this auxiliary unit is condensed in the feedwater heater giving the desired temperature.

F. The same arrangement as in "D" is used, except that certain of the auxiliaries, in addition to the motor, have a steam turbine drive, the motor receiving energy from the main generating unit or from the steam turbine, which later may be controlled from time to time so as to give just the amount of exhaust steam necessary to maintain the feedwater temperature.

In the above feed heating systems, except possibly "D," the temperature to which the feedwater may be raised is that of the temperature of the auxiliary exhaust steam. It would certainly be economical and beneficial, from the mechanical standpoint of a boiler, if the feedwater were heated somewhere near the temperature of evaporation. To do this, the water could be heated by steam direct from the boiler, but this would give a mechanical advantage only. The system "D," outlined above, could be arranged to bleed the steam from the main turbine at several points, each at a different pressure and each using its separate feedwater heater. This would certainly be economical, but would quickly become impracticable, because of the cumbersomeness of the heaters if many stages were employed.*

Use of Economizers

Another method of accomplishing this additional feed heating is by means of economizers, where the waste gases from the boilers pass through heating elements to which water is admitted at the temperature of the feed heater and brought up to as near boiler temperature as practical. Economizers have been used in marine practice. (Admiral Dyson shows an arrangement in his book on page 82 in the case of Belleville boilers.)

So far as land practice is concerned, economizers are accepted as a standard equipment, and they certainly are a vital factor in obtaining high plant efficiency. Where higher steam pressures are to be employed, it would seem that the economizers become practically necessary, if the full benefits of the high pressure are to be realized. At ordinary pressures, whether or not the cost of the installation is warranted, depends upon the cost of fuel and the maintenance charges of the economizers. It is probable that their installation can be shown to be warranted in almost any case from an economic standpoint.

Reference has been made to the condensing of the exhaust steam in the feedwater heater and it should be borne in mind that the condenser and the feedwater heater are exactly similar pieces of apparatus performing the same function, i. e., the use of water to condense steam. In one, the condensing of the steam is the primary object, and the heat is lost. In the other, the conservation of the heat is the primary object, and the condensing of the steam becomes secondary.

Types of Feedwater Heaters

As in condenser practice, there are surface and jet condensers, so with the use of feedwater heaters, there are surface and jet types. The jet types are usually referred to as open feedwater heaters, this name coming from an ancient land practice where the heater was actually opened to atmosphere. In marine work in this country the practice has been to use only the closed or surface type of feed heater, and this is probably one of the contributing causes of the severe corrosion often found in boilers and turbines aboard ship. With this form of heater it is usual for the water to enter at a pressure in excess of that of the boiler and, therefore, even though it may be heated to a temperature of 235 degrees F., it is very far from the actual boiling point. With a feedwater pressure of 300 pounds and a temperature of 235 degrees F., the water is 187 degrees below the temperature of evaporation. The result of this is that the air which is almost certain to be included in the feed-

*A discussion of this is given in Dinger's "Naval Machinery," pages 160 to 163.

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water, does not separate or boil off from the water. Were the water in this same heater kept at the pressure corresponding to the temperature, a very large percentage of the air would be driven out and, if the jet form of heater were used, where the water and steam actually mixed, a very large percentage of the air would be expelled without difficulty. By proper venting of the heater, this air can be permanently removed from the feed.

This jet form of heater might well be incorporated with the feed and filter tank, or if it were still desired to have them separate, the feed and filter tank could be raised and the water allowed to flow to the jet heater and the feed pumps would draw their water from it and deliver it to the boilers. It is obvious that the heater must be located at some elevation above the feed pump so that the water actually in the pump will be below the temperature of evaporation, although the water in the heater may be actually boiling.

With this type of heater vented through a small tubular heater, so that any steam escaping with the air is condensed by the feed passing through the tubular heater, it is possible to obtain a feed temperature corresponding to the temperature of evaporation of the pressure in the heater and this is done without wasting any heat or permitting any steam to escape to atmosphere.

OXYGEN IN THE FEEDWATER

It is very easy for oxygen to enter the feed system and it is very important that as much of it as possible be removed. A common cause of air in the feed is leaks in the glands or stuffing boxes of the feed pumps. Another common cause is for the feedwater to fall through the open air

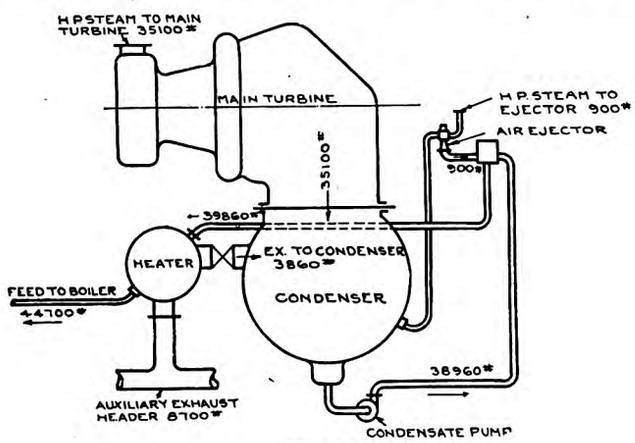

Fig. 2

into the feed and filter tank; this may be very serious. Slight air leaks in the vacuum system are responsible for considerable oxygen in the feed. It is, therefore, desirable to keep the system as tight as possible and to take every precaution to prevent air getting into the feed, and, in addition, to do whatever can be done to drive the air out of the feed after its unpreventable inclusion.

Taking up again the types of auxiliaries and their relation to the feed heating system in merchant marine work, none of the arrangements "A" to "F," inclusive, listed above, is ordinarily employed. This is because the load condition is essentially a constant one. Practically all of the auxiliaries are steam driven, each with its independent steam cylinder, engine or turbine, and it is almost certain that the steam which will be exhausted from these various units, which are necessary to the operation of the ship, will be in excess of that required for feedwater heating.

PRACTICAL HEAT BALANCE EXAMPLES

Bearing in mind that the passing of heat to the condenser must be avoided, any improvement in the efficiency of the steam consumption of the auxiliary units is desirable. This is perhaps best illustrated by examples of heat balance under conditions approximating those actually obtained in practice. These examples are based on a cargo-carrying ship equipped with geared turbine driven propelling machinery and operating the greater part of the time at the normal load of 3,000 shaft horsepower. The steam pressure is assumed to be 200 pounds gage at a quality of 98 percent and the vacuum in the exhaust is assumed to be 28½ inches mercury referred to a 30-inch barometer.

Table 2 gives the assumed power and steam consumption of the various auxiliaries as they would be operated under the average steaming condition.

TABLE 2

Auxiliary	Type	Horse-power	Pounds Steam per Hour
Boiler feed pump	Reciprocating	15	1,500
Boiler fuel oil pump	Reciprocating	2	200
Boiler blowers	Centrifugal, engine driven	12	500
Condenser circulating pump	Centrifugal, geared turbine drive	60	2,300
Condenser air removal apparatus	Ejectors		900
Condenser condensate pump	Centrifugal, turbine drive	4	400
Turbine lubricating oil pump	Reciprocating	2	200
Lighting set—15 kilowatts	Turbine Drive	23	1,100
Miscellaneous auxiliaries	Reciprocating and turbine drive	30	2500
	Total	152	9,600

Example 1—Steam Driven Auxiliaries—No Feed Heating

Steam pressure—200 pounds gage.
Steam—98 percent quality.
Vacuum in exhaust—28½ inches.

Shaft horsepower—3,000.
Steam consumption—main turbines—11.7 pounds per shaft horsepower.
Total steam per hour..... 35,100 pounds
Principal auxiliaries (= 118 horsepower) steam per hour.... 6,200 pounds
Miscellaneous auxiliaries—steam per hour..... 3,400 pounds
(including air removal from condenser)

Total steam generated per hour..... 44,700 pounds

Total heat in steam above 32 degrees F..... 1,181.9 British thermal units
Temperature of condensate—90 degrees F.
Heat of liquid in condensate..... 58.1 British thermal units

Heat added per pound of feed to make steam... 1,123.8 British thermal units

$$\text{British thermal units consumption } \frac{1{,}123.8 \times 44{,}700}{3{,}000} = 16{,}750 \text{ per shaft h'power}$$

Assuming fuel oil of 18,500 British thermal units per pound, and a boiler room efficiency of 78 percent, the fuel consumption would be—
16,750 ÷ (18,500 × 0.78) = ...1.16 pounds per shaft horsepower

Example 1-a

Conditions the same as in Example 1 except all auxiliaries are reciprocating with the exception of the blowers. Then the auxiliary steam consumption would be increased to about.....15,000 pounds per hour
The fuel consumption would be.....1.31 pounds per shaft horsepower hour

Example 2—Steam Driven Auxiliaries—Fig. 2

Feed heated to 235 degrees F., excess exhaust to condenser.
Steam pressure—200 pounds gage—98 percent quality.
Vacuum—28½ inches.

Shaft horsepower—3,000.
Steam consumption—main turbines—11.7 pounds per shaft horsepower hour.
Total steam, pounds per hour..... 35,100
Principal auxiliaries (118 horsepower).
Principal auxiliaries steam per hour, pounds..... 6,200
Miscellaneous auxiliaries steam per hour, pounds..... 2,500
Air ejectors steam per hour, pounds..... 900

Total steam per hour, pounds..... 44,700
Total heat in air ejectors—steam above 32 degrees F. 1,100 British thermal units
(Note—The ejectors have done work in removing air from the condenser.)
Temperature of condensate 90 degrees F.
Heat of liquid..... 58.0 British thermal units

Heat in each pound of ejector steam available for heating ..... 1,041.9 British thermal units

Total British thermal units in ejector steam 1,041.9 × 900 = 938,000 British thermal units per hour.

$$\text{Rise in feed temperature} = \left(\frac{938{,}000}{35{,}100 \times 900}\right) = 26 \text{ degrees F. (See note.)}$$

Temperature of feed and filter tank—116 degrees F.

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British thermal units needed per pound of feed to heat to 235 degrees F. = 235 — 116 = 119.

$$\text{Total exhaust steam needed} = \frac{36{,}000 \times 119}{1{,}000} = 4{,}280 \text{ pounds}$$

Note—It is assumed that each pound of exhaust steam condensed at 235 degrees F. will give up 1,000 British thermal units.

This will leave 8,700 — 4,280 = 4,420 pounds of exhaust steam not usable in the heater, and part will go to the condenser and part will be used to heat the first part in the feed heater. The error made in assuming 1,000 British thermal units given up in condensing in either heater or condenser will be very small; therefore, if X = amount of steam to condenser, 4,420 — X equals the amount used to heat it from 90 degrees to 235 degrees F. This requires 145 British thermal units per pound, or

$X \times 145 = (4{,}420 - X) \times 1{,}000$ or $1{,}145\ X = 4{,}420{,}000$

or X = 3,860 pounds to the condenser and 560 pounds used in the heater.

Whether the steam condensed in the heater goes to the feed and filter tank, raising the temperature there, or whether it mixes directly with the feed, will make so little difference in this heat balance that it is assumed to mix with the feed.

Total heat in steam above 32 degrees F.....	1,181.9 British thermal units
Heat in liquid of feed at 235 degrees F.....	203.6 British thermal units
Heat added to feed per pound to make steam..	978.3 British thermal units

British thermal units consumption =

$$\frac{978.3 \times 44{,}700}{3{,}000} = 14{,}580 \text{ pounds per shaft horsepower}$$

Fuel consumption = 14,580 ÷ (18,500 × 0.78) = 1.01 pounds per shaft horsepower hour.

(Note—There being an excess of exhaust steam for feed heating, the final result would be the same if the heating from the ejector steam were calculated as if occurring in the feed heater.)

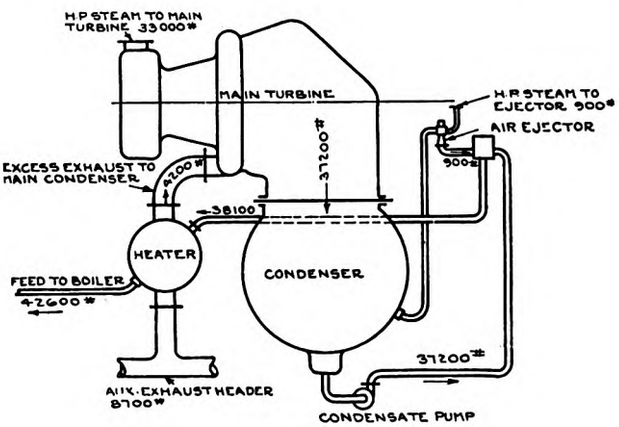

Fig. 3

Example 3—Steam Driven Auxiliaries—Fig. 3

Feed heated to 235 degrees F.—excess exhaust to main turbine.
Steam pressure—200 pounds gage—98 percent quality.
Vacuum—28½ inches.

Shaft horsepower—3,000.
Total auxiliary exhaust—pounds per hour—9,600 pounds.
Excess auxiliary exhaust admitted at point of main turbine where pressure is 18 pounds absolute. Then for adiabatic expansion—

British thermal units at 215 pounds absolute 98 percent quality.....	1,181.9
British thermal units at 28½ inches vacuum.....	834.8
	347.1
British thermal units at 18 pounds absolute.....	1,003.7
British thermal units at 28½ inches vacuum.....	834.8
	168.9

Therefore, steam entering the main turbines at 18 pounds absolute will do approximately $\frac{168.9}{347.1} = 49$ percent of the work of high pressure steam.

The error in assuming that one pound of exhaust steam will do work in the low pressure end, which will save one-half pound of high pressure steam, is very small.

Let X = the pounds of auxiliary exhaust steam per hour which passes into the main turbine:

Then 9,600 — X is the amount used in heating feed and $\frac{X}{2}$ is the amount of high pressure steam saved. Total steam to condenser equals high pressure steam or $3{,}000 \times 11.7 - \frac{X}{2} = 35{,}100 - \frac{X}{2}$, plus the exhaust steam admitted to the turbine or X pounds or the total condensate is

$$\left(35{,}100 - \frac{X}{2}\right) + X = 35{,}100 + \frac{X}{2}$$

The British thermal units per pound of feed needed to heat from a condensate temperature of 90 degrees to 235 degrees F. = 145 or the exhaust steam needed for heating equals

$$(9{,}600 - X) = \left(35{,}100 + \frac{X}{2}\right) \times 145 \div 1{,}000$$

(1,000 British thermal units is the heat given up in condensing each pound of exhaust.)
Therefore, X = 4,200 and 9,600 — X = 5,400.

The total main turbine high pressure steam = $35{,}100 - \frac{4{,}200}{2}$ =	33,000
The total auxiliary steam per hour = ...	9,600
Therefore, the total feed in pounds per hour = ...	42,600

From Example 2, the heat required per pound of feed to generate steam = 978.3 British thermal units;

and the British thermal units consumption = $\frac{978.3 \times 42{,}600}{3{,}000}$ = 13,900 pounds per shaft horsepower.

Fuel consumption equals 13,900 ÷ (18,500 × 0.78) = 0.96 pound per shaft horsepower hour.

Example 3-a

Conditions the same as in Example 3 except that as in Example 1-a all auxiliaries, with the exception of the blowers, are reciprocating.
Total auxiliary exhaust—pounds per hour = 15,000.

$$\text{Then } (15{,}000 - X) = \left(35{,}100 + \frac{X}{2}\right) \times 145 \div 1{,}000$$

or X = 9,250 pounds and 15,000 — X = 5,750 pounds.

Total main turbine high pressure steam = $35{,}100 - \frac{9{,}250}{2}$ =	30,475
Total auxiliary steam = ...	15,000
	45,475

Therefore, fuel consumption equals 1.03 pounds per shaft horsepower hour.

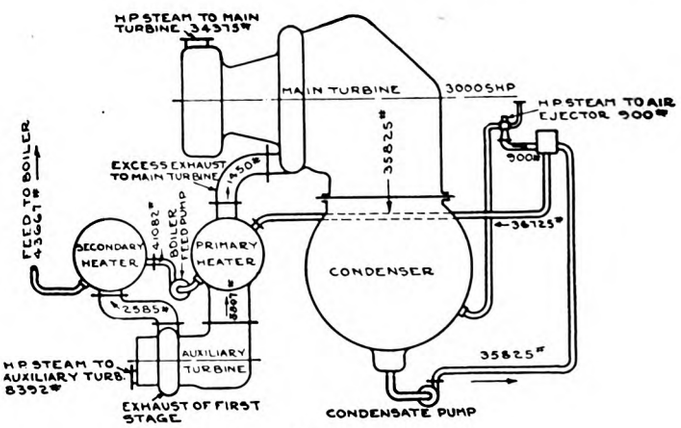

Fig. 4

Example 4—Circulating Pump and Boiler Feed Pump Driven from Main Turbine—Other Auxiliaries Separately Steam Driven

Total shaft horsepower to propeller = 3,000.
Additional shaft horsepower to drive circulating and boiler feed pumps = 80.
(Note—Allow 5 shaft horsepower additional for drive of boiler feed pump.)
Total auxiliary exhaust = 5,800 pounds.
Then, as in Example 3:

High pressure steam to main turbine = $3{,}080 \times 11.7 - \frac{X}{2}$

equals 36,050 pounds $- \frac{X}{2}$ and total exhaust

equals 36,050 pounds $+ \frac{X}{2}$ pounds per hour.

or $(5{,}800 - X) = \left(36{,}050 + \frac{X}{2}\right) \times 145 \div 1{,}000$

or X = 535 pounds and 5,800 — X = 5,465 pounds.

The total main turbine high pressure steam = $36{,}050 - \frac{535}{2}$ =	35,782
The total auxiliary high pressure steam = ...	5,800
Therefore, the total feed in pounds per hour = ...	41,582

The British thermal units consumption = $\frac{978.3 \times 41{,}582}{3{,}000}$ = 13,560 per shaft horsepower,
and fuel consumption = 13,500 ÷ (18,500 × 0.78) = 0.94 pound per shaft horsepower hour.

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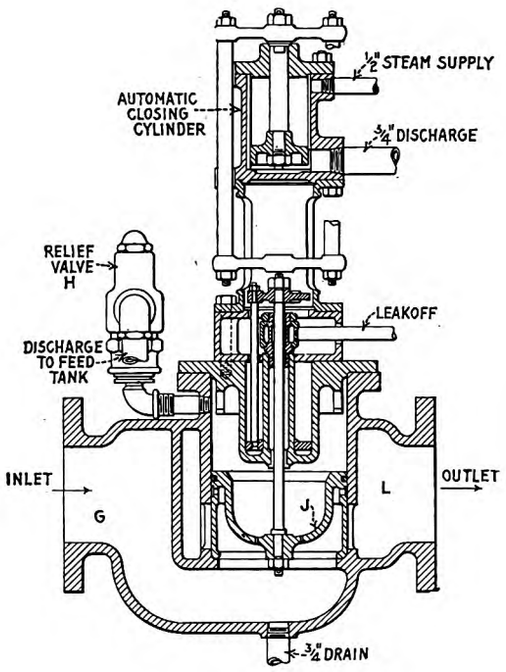

Fig. 5

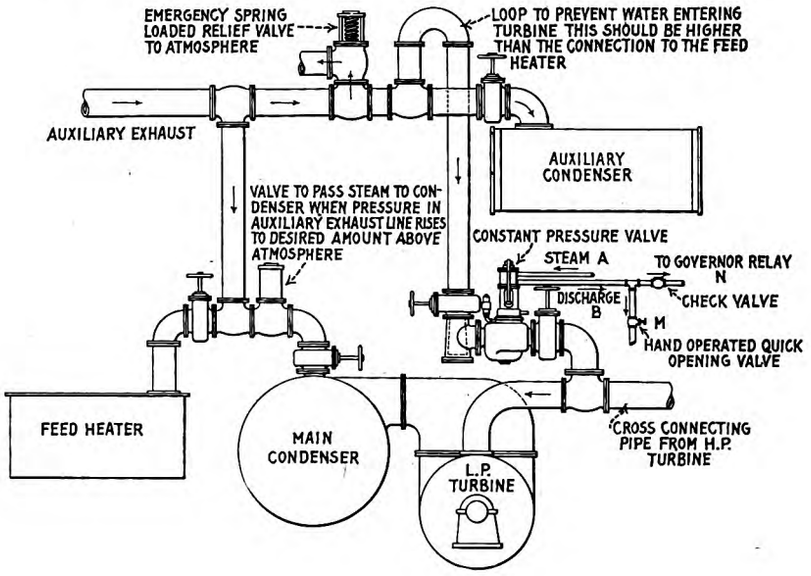
EMERGENCY SPRING LOADED RELIEF VALVE TO ATMOSPHERE
LOOP TO PREVENT WATER ENTERING TURBINE THIS SHOULD BE HIGHER THAN THE CONNECTION TO THE FEED HEATER
AUXILIARY EXHAUST
AUXILIARY CONDENSER
VALVE TO PASS STEAM TO CONDENSER WHEN PRESSURE IN AUXILIARY EXHAUST LINE RISES TO DESIRED AMOUNT ABOVE ATMOSPHERE
CONSTANT PRESSURE VALVE
STEAM A
TO GOVERNOR RELAY N
DISCHARGE B
CHECK VALVE
M
HAND OPERATED QUICK OPENING VALVE
FEED HEATER
MAIN CONDENSER
L.P. TURBINE
CROSS CONNECTING PIPE FROM H.P. TURBINE

Fig. 6

Conditions Assumed in Examples

It will be seen that in all of the above examples the conditions outlined in arrangement "A" are only approximated, as it is impracticable to have any electrically driven auxiliaries receiving their power from the main power unit. Example 4 approaches most nearly to the conditions of arrangement "B" and in the arrangements suggested for Example 3 and 4, the automatic valve for admission of the auxiliary exhaust steam to the main unit is quite desirable as there will always be some steam going through this connection. Such a valve is shown in Fig. 5 and its arrangement in the ship, in Fig. 6.

The excess steam from the auxiliary exhaust line would enter at *G*, Fig. 5, passing out to the turbine at *L*. A small amount of steam leaks past piston *J* and its pressure is regulated by the relief valve *H*, which can be set to any desired pressure. Steam entering at *G* will tend to build up a pressure under piston *J* and will cause it to lift until the pressure in *G* balances the pressure maintained by the relief valve when the piston *J* will remain stationary, allowing the steam to flow through the ports indicated into *L* irrespective of the pressure in *L* as long as it is below the pressure at the inlet *G*.

The mechanism shown on the top of the valve is connected to the maneuvering valve and to an overspeed governor so that in case it is necessary to shut off steam to the main unit, this automatic "constant pressure valve" will be shut at the same time the main steam inlet is shut, allowing the excess steam to go direct to the main or auxiliary condenser through a suitable relief valve which is set at a higher pressure than is desired in the exhaust line normally.

Examples 1 to 3 show how the fuel consumption of the ship has been reduced 17½ percent by the method of feed heating, using the same equipment of main and auxiliary units. Example 4 shows how a further reduction of 3 percent in total fuel can be effected by driving certain of the auxiliary units directly from the main power unit.

It might, of course, be desirable to extend the arrangement suggested in Example 5 so as to approximate the conditions of arrangement "D," in which all the auxiliaries would be driven from the main unit, the feed heating being accomplished by bleeding steam from the main turbine and with such an arrangement, if it were possible, a fuel consumption of 0.845 pound per shaft horsepower hour could be obtained. Such an arrangement would be too complicated and, of course, in the case of many auxiliaries, it would be entirely impracticable to drive them directly as such an arrangement necessitates that most of the auxiliaries be capable of being operated when the main unit is shut down and this would run into excessive duplication.

It is possible, however, to employ arrangement "E" and with the modern development of electrical apparatus, there seems to be no reason why such a drive for all of the auxiliaries, the driving motor receiving its power from a central generating unit, cannot be sucessfully employed. Example 5 indicates the economy of such an arrangement.

Example 5—All Auxiliaries Motor Driven Except Air Ejector

Motors supplied with power from a two-stage turbine driven generator. Steam bled from the exhaust of the first stage into a secondary feed heater and the turbine exhausting into a primary feed heater with the excess going to the main turbine. See Fig. 4.
Total auxiliary power (see Table 1), 152 horsepower.
Assuming 80 percent average motor efficiency, the load on the generator will be 142 kilowatts.
(200 kilowatt generating sets would be used to allow a margin of power.)
First stage of turbine, inlet pressure, pounds per square inch absolute..155
First stage of turbine, exhaust, pounds per square inch absolute..... 65
Total British thermal units available for work..... 67.5
Exhaust pressure of turbine.....25 pounds absolute
Total British thermal units available for work from 155 absolute to 25 pounds absolute 135
Therefore, first stage does about 50 percent of the total work or each pound of steam bled from first stage requires one-half pound to be added to maintain the required power.
Steam consumption complete unit in pounds per kilowatt hour..... 50
Total steam, if no steam bled = 50 × 142 = ... 7,100 pounds per hour
Steam per hour from ejector = ... 900

Total (no bleeding) ..... 8,000 pounds per hour

Temperature of steam at 65 pounds absolute = 298 degrees F.
Let X = exhaust steam to main turbine.
Y = steam bled from first stage of auxiliary turbine.
$\frac{Y}{2}$ = amount of high pressure steam added to make up for bleeding.

then $\left(35{,}100 + \frac{X}{2}\right)$ = pounds steam per hour (see Example 3) to condenser.

$\left(8{,}000 - \frac{Y}{2}\right)$ = pounds steam per hour exhausted from auxiliary turbine and ejector.

Assume primary heater heats the feed from 90 degrees to 235 degrees F., and the secondary heater from 235 degrees F. to 298 degrees F.

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Then the heat added in primary heater

$= \left(35{,}100 + \frac{X}{2}\right) \times 145 = (5{,}090{,}000 + 72.5\ X)$ British thermal units per hour.

The steam used for this $= \left(8{,}000 - \frac{Y}{2}\right) - X$

or $\left(8{,}000 - \frac{Y}{2}\right) \times 1{,}000 - 1{,}000\ X = 5{,}090{,}000 + 72.5\ X$

or X = amount of exhaust steam to main turbine = 2,710 — 0.466 Y pounds per hour.

The total feed to secondary heater

$= \left(35{,}100 - \frac{X}{2}\right) + 8{,}000 - \frac{Y}{2} = 43{,}100 - \frac{(X + Y)}{(2)}$

The heat added in secondary heater

$= \left[43{,}100 - \frac{(X + Y)}{(2)}\right] \times (298 - 235) = 2{,}715{,}000 - (X + Y) = 31.5$

or $1{,}000\ Y = 2{,}715{,}000 - 31.5\ (X + Y)$, but $X = 2{,}710 - 0.466\ Y$

$1{,}000\ Y = 2{,}715{,}000 - 31.5\ (2{,}710 + .534\ Y) = 2{,}629{,}600 - 16.8\ Y$

$Y = 2{,}585$ pounds

$X = 1{,}450$ pounds

Total steam to main unit $= 35{,}100 - \frac{X}{2} =$ 34,375 puonds per hour

Total steam to auxiliary turbine and ejector $= 8{,}000 + \frac{Y}{2} =$ 9,293 pounds per hour

Total feed at temperature of 298 degrees F. 43,668 pounds per hour

British thermal units above 32 degrees per pound of steam..... 1,181.9

British thermal units above 32 degrees per pound water at 298 degrees F. 267.8

British thermal units added to feed per pound of steam..... 914.1

The British thermal unit consumption $= \frac{914.1 \times 43{,}668}{3{,}000} = 13{,}300$

Fuel consumption equals 13,300 ÷ (18,500 × 0.78) = 0.92 pound per shaft horsepower hour.

Note—Peabody's Steam Tables were used for these calculations.

By the use of a single pass condenser and a propeller type circulating pump, the power needed for this unit could be reduced 40 percent, or from 60 to 36 horsepower, and by careful proportioning of other auxiliaries it might be possible to reduce the auxiliary power from 152 horsepower to 115.

Example 5-a

Total auxiliary power..... 115 horsepower

Generator load ..... 108 kilowatts

(150 kilowatt generating sets could be used.)

Auxiliary turbine designed as in Example 5 as to stage pressures, etc.

Total steam, if no steam bled = 51 × 108 = ... 5,500 pounds per hour

Ejector ..... 900 pounds per hour

Total ..... 6,400 pounds per hour

then as in Example 5—

$\left(6{,}400 - \frac{Y}{2}\right) \times 1{,}000 - 1{,}000\ X = 5{,}090{,}000 + 72.5\ X;$

$X = 1{,}220 - 0.466\ Y$

Feed to secondary heater $= 35{,}100 - \frac{X}{2} + 6{,}400 - \frac{Y}{2} = 41{,}500 - \frac{X + Y}{2}$

The heat added in secondary heater

$= \left(41{,}500 - \frac{X + Y}{2}\right) \times (298 - 235) = 2{,}610{,}000 - 31.5\ (X + Y)$

or $1{,}000\ Y = 2{,}610{,}000 - 31.5\ (1{,}220 + 0.534\ Y) = 2{,}571{,}600 - 16.81$

$Y = 2{,}530$ $X = 40$ pounds (or practically nothing)

In other words, the auxiliary exhaust is just sufficient to heat the feed by use of two stage heating.

Total steam to main unit = ... 35,080 pounds per hour

Total steam to auxiliary turbine ejector $= 6{,}400 + \frac{Y}{2} =$ ..... 7,665 pounds per hour

Therefore, total feed at temperature of 298 degrees F. 42,745 pounds per hour

Birtish thermal units added per pound of feed — 914.1.

British thermal units consumption = 13,000 per shaft horsepower hour and fuel rate = 0.9 pound per shaft horsepower hour.

It is interesting to note the result if only the primary heater were employed, using the same turbine and auxiliaries as in Example 5.

Total auxiliary exhaust..... 8,000 pounds per hour

then $8{,}000 - X = \left(35{,}100 + \frac{X}{2}\right) \times 145 \div 1{,}000$

$X = 1{,}875$ and $8{,}000 - X = 6{,}125$

Total high pressure steam to main turbine = ... 34,163 pounds per hour

Total auxiliary steam..... 8,000 pounds per hour

Total feed ..... 42,163 pounds per hour

British thermal units rate = 13,750.

Fuel consumption = 0.955 pound per shaft horsepower hour

or 5 percent higher for the *same equipment*, but not employing two stage heating.

Electric Drive Auxiliaries

While the use of steam driven auxiliaries has been considered necessary in the past, this idea has been undergoing modification in land power plants. The steam driven unit used to be considered as the most reliable and, while the various units were usually small and uneconomical, it was generally considered that this was unimportant and that since the exhaust steam was either condensed in a feed-water heater or did work in the main turbine, that the actual economy of the unit made no difference. As has been pointed out, however, there may be a big difference in the overall results, as with a more economical drive, less steam would be required to produce the auxiliary power with the saving in total fuel as pointed out above. At the present time, however, electric motors and their circuits are probably even more reliable than the small steam driven units and can be counted on to maintain their functions with less danger of stoppage or interruption. This is certainly true in land practice and will undoubtedly become equally true in marine practice as waterproof motors, wiring and controls are more fully developed.

For the vital auxiliaries the arrangement "F" with both motor and steam turbine drive, should be employed, or duplicate steam driven units should be installed. In the case of the circulating pump, the dual drive of motor and turbine would be suitable. For the feed pump and fuel oil pump, a stand-by steam driven unit would probably be chosen. Duplicate condensate pumps, each with motor drive, would be satisfactory for the main condenser, as these units could be shut down for a reasonable length of time without jeopardizing operation. The same is true of lubrication oil pumps and most of the auxiliaries.

Care must, of course, be taken to insure against interruption of electric circuits and the control of the vital engine room auxiliaries should be grouped together as separate as possible from the circuits for the general ship service. Circuit breakers or other protective devices on the general power and lighting circuits should be more sensitive than those for the vital auxiliaries and it is not improbable that automatic interrupting devices would be eliminated from these latter circuits. Where the total power is sufficient, it is desirable to keep the generating units for the vital auxiliaries separate from those for the general ship's circuits. Where the power is too small, the bus for the one could be connected to the generator without automatic circuit breakers, while the bus for the other general circuit could be protected by such breakers.

While the question may be raised that the improvements of efficiency shown by the various arrangements discussed, may be offset by other conditions, it must be remembered that the relative gains indicated will be realized, although it may be difficult to actually measure them in a comparison of any actual installations. Thus, the installation which should show a fuel consumption of 0.92 pound per shaft horsepower hour may be handicapped by poor boiler room efficiency and actually have a poorer consumption than should be given by Example 3, which might in practice have a higher boiler room efficiency. If, in Example 3, the boiler room efficiency were 80 percent, the fuel consumption would be 0.94 pound per shaft horsepower hour, while, if in Example 5, the boiler room efficiency were 65 percent instead of 78 percent, the fuel consumption would be 1.11 pounds per shaft horsepower hour. On the other hand, the rate of 0.94 would have been reduced to 0.90 by the change in auxiliary drive and feed heating outlined. A common reason for not maintaining the highest possible attainable efficiency of a given plant is that it is difficult to

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actually measure the benefits or the gains derived from improvements because of other changes taking place which tend to offset the gains and it is, therefore, sometimes advisable to listen to the "theorists" rather than to the so-called "practical man" who can only believe what he can measure with a rule or scale.

IMPORTANCE OF AUXILIARY ECONOMY

The importance of auxiliaries in obtaining economical operation cannot be too strongly emphasized. They should be so maintained as to give their best possible performance at all times. Mere ability to operate without stopping is not enough. A recent test of a small engine driven lighting set supposed to operate on less than 100 pounds of steam per kilowatt hour, showed an actual consumption of over 300 pounds per kilowatt hour. The engine ran fairly well, but leaky pistons, changes in valve settings, etc.,

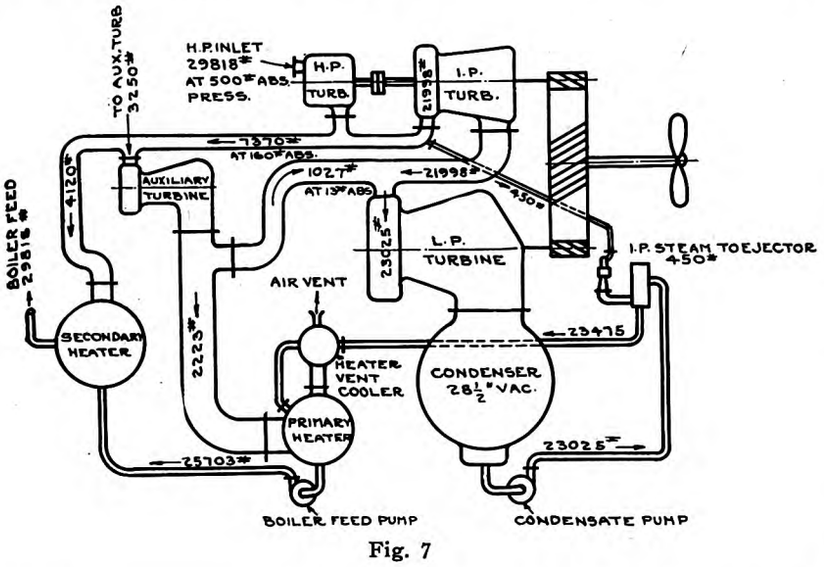

Fig. 7

caused the enormous increase in steam consumption. Similarly, other pumps and engines can soon deteriorate so that the total auxiliary consumption is excessive and the condition assumed in Example 2-a is a real one.

Occasional tests of the steam consumption of the various auxiliaries while in port is not only practicable, but well worth while.

MAINTAINING A HIGH VACUUM

There are, of course, many other departments in which improvements in efficiency can be realized by care and knowledge of the fundamental characteristics of the apparatus. This is particularly true in relation to the condenser and the vacuum maintained under varying conditions of sea water temperature, etc. A tight vacuum system and clean tubes, both inside and out, are well repaid in maintenance of high efficiency. The accumulation of oil and grease on the surface of the condenser tubes may readily give a loss in vacuum of 1 inch and this will affect the overall efficiency from 4 to 6 percent. One inch of vacuum may readily be lost by air leaks and an equal amount by clogging up of the circulating cooling water system, particularly the condenser tubes.

WASTE GAS AIR HEATERS

Economizers have been suggested, too, and what is perhaps more common in ships, the use of air heaters, in which the waste gases preheat the air to the burners. Where higher boiler pressures are to be employed, it is possible that both economizers and air heaters may prove advantageous. With the high temperature feedwater heating that has been referred to above, the use of an economizer to further heat the feed from 300 degrees to 350 degrees and the use of air heaters placed in the gases after they have been passed through the economizers would result in very low stack temperatures with a definite gain in overall economy. It must be realized that the art of building economizers is progressing and many of the problems in the past which have been found difficult are now solved and such pieces of apparatus can no longer be considered impracticable, even though their cost may be formidable.

With the use of such equipment, the assumed boiler efficiency of 78 percent might be readily increased to 87 percent and our fuel consumption in Example 5 would be reduced from 0.92 to 0.823 pound per shaft horsepower hour.

The use of high steam pressure and superheats has been referred to and it is of interest to study along the same line of the preceding examples what fuel consumptions could be expected in such an installation. For this study, a boiler pressure of 600 pounds gage, superheating the steam 200 degrees F. has been assumed. Superheaters, economizers and air heaters would all be employed and the auxiliaries would all be motor driven as in Example 5. The main turbine would be divided into three portions, consisting of a high pressure turbine, intermediate pressure turbine and low pressure turbine. The high pressure turbine would take steam at 500 pounds absolute (allowing a 115-pound drop between boiler and turbine) and would exhaust to a pressure of 160 pounds absolute. The intermediate pressure turbine would take steam at this pressure and exhaust at 13 pounds absolute, and the low pressure turbine would exhaust to a 28½-inch vacuum as previously assumed. (Other pressure distributions may be found to be even more economical, depending on the actual installation.)

The auxiliary power generating unit and the ejector would take their steam from the exhaust of the high pressure turbine and would in turn exhaust through a feedwater heater to the inlet of the low pressure turbine (Fig. 7). There would also be a feedwater heater in parallel with the inlet of the auxiliary turbine, taking its steam from the exhaust of the main high pressure turbine. The auxiliary turbine would be equipped with an automatic valve, which in case of shutting down on the main unit, would admit boiler steam directly and thus prevent any interruption of service due to sudden maneuvering of the main unit. This valve could also be actuated by hand so that during maneuvering of the main unit, the auxiliary unit would be operated independently.

Example 6 shows the probable consumption from such an arrangement:

Example 6—Fig. 7

600 pounds boiler pressure, 200 degrees F. superheat.
Auxiliaries driven by motors.
Auxiliary power generated by turbine receiving steam from main unit at end of first stage, exhausting to heater and inlet of low pressure stage.
Two-stage feed heating.
Allow 115 pounds drop to main turbines.
Inlet pressure, main turbine, pounds per square inch absolute, 500.
Total heat in steam above 32 degrees F.—British thermal units per pound, 1,352.
Exhaust of high pressure turbine, pounds per square inch absolute, 160; temperature, 364 degrees F.
Exhaust of intermediate pressure turbine, pounds per square inch absolute, 13; temperature, 236 degrees F.
Vacuum in low pressure turbine exhaust, 28½ inches; temperature, 92 degrees F.
Percent total work done in high pressure = 25 or ¼ of total.
Percent total work done in low pressure = 33⅓ or ⅓ of total.
Steam consumption—main unit with no bleeding or heating, 8.10 pounds per shaft horsepower hour
or a total of 8.10 × 3.000 = 24,300 pounds per hour.
Auxiliary unit taking steam at 160 pounds absolute (and 160 degrees superheat)

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exhausting to 13 pounds absolute will have a steam consumption of 31 pounds per kilowatt.
Total steam consumption of *one* turbine = 105 × 31 = 3,250 pounds per hour.
(Note—Amount of circulating water greatly reduced.)
Condensing type ejector..... 450 pounds per hour

Total ..... 3,700 pounds per hour

Let X = steam per hour from auxiliary turbine exhaust not used in primary heater into low pressure inlet of main turbine.
Let Y = steam per hour bled from intermediate pressure inlet to auxiliary turbine and secondary heater,
then 3,700 — X = amount of steam used in primary heater.
Y = 2,700 amount of steam used in secondary heater.

$$\text{High pressure steam to main turbine} = 24{,}300 + \frac{3Y}{4} - \frac{X}{3}$$

(For every pound bled out at 160 absolute ¾ pound must be added to go through whole of main unit to do the work required.)

$$\text{Steam to condenser} = 24{,}300 - \frac{Y}{4} + \frac{2X}{3}$$

The primary heater heats from 90 degrees to 206 degrees F. for 116 degrees,

$$\text{then } 1{,}000\ (3{,}700 - X) = \left(24{,}300 - \frac{Y}{4} + \frac{2X}{3}\right) \times 116$$

or $X = 816 + 0.027Y$
Feed to secondary heater equals steam to condenser plus

$$3{,}700 - X \text{ equals } 28{,}000 - \frac{Y}{4} - \frac{X}{3}$$

The secondary heater heats from 206 degrees to 364 degrees F. = 158 degrees,

$$\text{then } 1{,}000\ (Y - 3{,}700) = \left(28{,}000 - \frac{Y}{4} - \frac{X}{3}\right) \times 158$$

$Y = 7{,}820$ $\quad Y - 3{,}700 = 4{,}120$ pounds
$X = 1{,}027$ $\quad 3{,}700 - X = 2{,}673$ pounds
Total steam to high pressure unit = 24,300 + 5,860 — 342 equals 29,818 pounds per hour.
The total heat of the steam = ... 1,352 British thermal units
The temperature of feed 364 degrees.
The British thermal units of liquid in feed — ... 336

Heat added to make steam = ... 1,016 British thermal units

British thermal unit rate = 29,818 × 1,016 ÷ 3,000 = 10,100
With economizers, air heaters and superheaters, a boiler efficiency of 87 percent can be counted on.
Therefore, the fuel consumption based on a heat value of 19,500 British thermal units per pound equals
10,100 ÷ (19,500 × 0.87) = 0.595 *pound oil per shaft horsepower hour.*

Chamber of Commerce Meeting.—At the eleventh annual meeting of the Chamber of Commerce of the United States, to be held in New York, May 7 to 11, "Transportation in all its phases in the United States" and "Europe's Affairs" will be the main topics of discussion.

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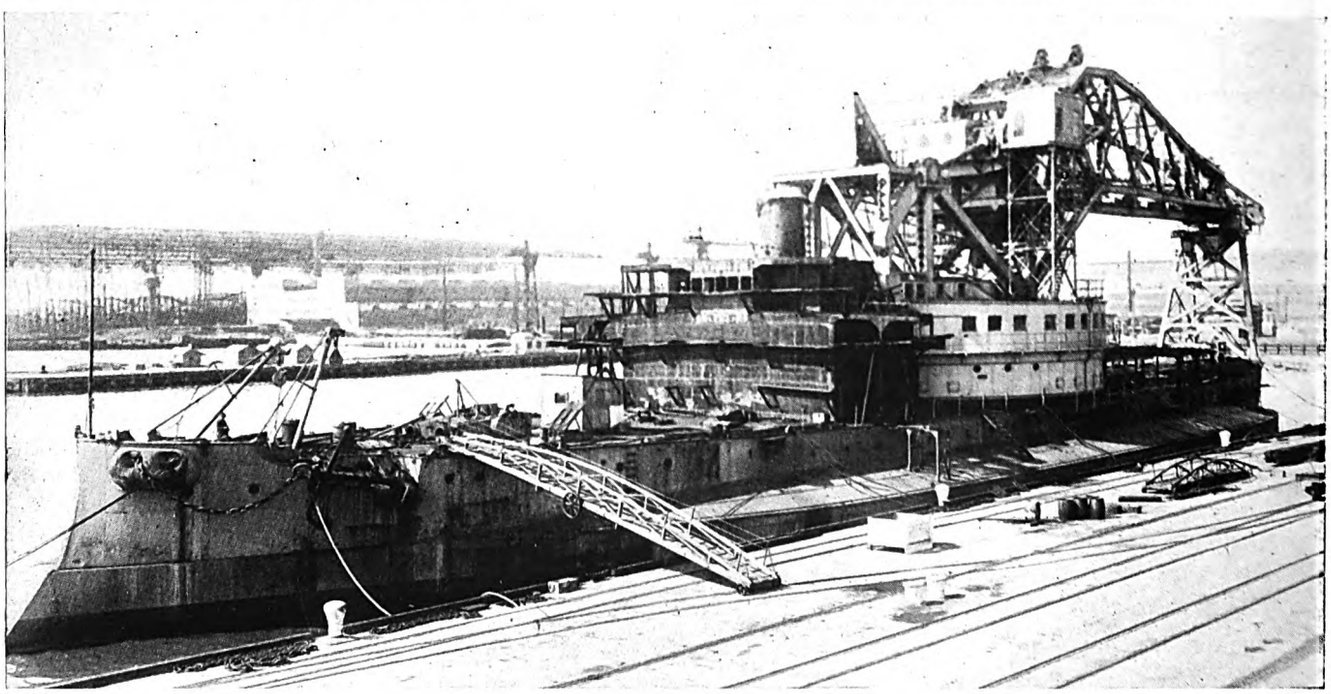
Stern View of 250-Ton Floating Crane Kearsarge



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Former United States Battleship Kearsarge Converted Into Crane Ship at Philadelphia Navy Yard. The Crane Installed On This Hull Has a Capacity for Lifting 250 Tons

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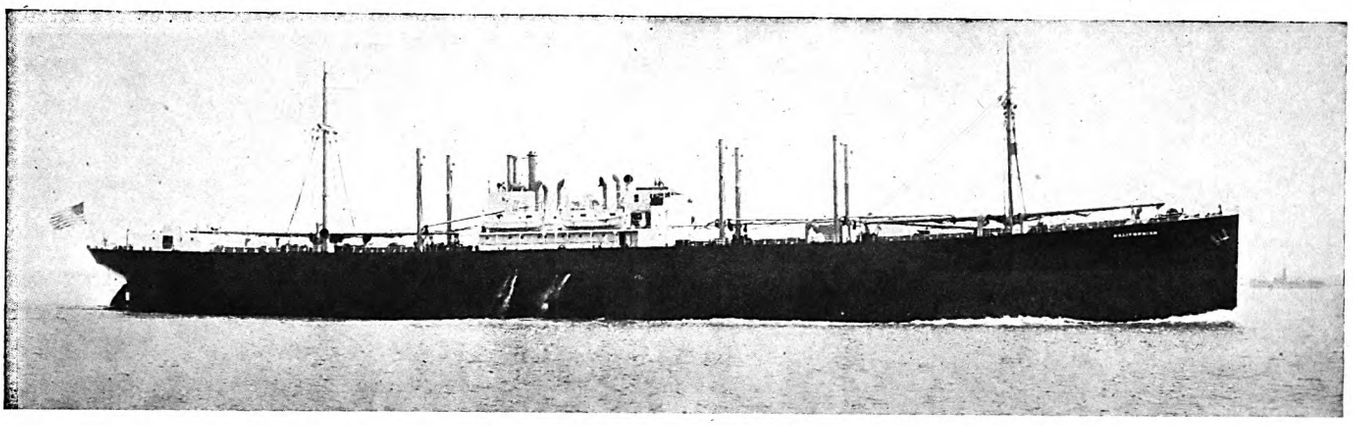

Motorship Californian of the American-Hawaiian Steamship Company

Are Motorships the Most Economical Type of Vessel?

Comparison of Fuel Costs With Coal and Oil Fired Steamers Explains Growth of Motorship Building in Europe

By Our Special London Correspondent

THERE still remains a suspicion in the minds of many shipowners that a large proportion of the statements made relating to the economies which it is possible to effect by employing oil engines for ship propulsion are not founded on facts but are mere estimates which may, or may not, be borne out in actual practice. In dealing with the subject, it is therefore of the first importance to give some information relating to the fuel consumption of corresponding steam and motorships, attained during the course of normal service and under similar conditions.

It has to be borne in mind that it is not a sufficient inducement to the shipowner for the advocate of the oil engined vessel merely to show a certain reduction in the fuel bill as compared with the steamer. The initial cost of a motorship is considerably higher than that of one fitted with a steam plant, and the economies effected in operation must therefore be of sufficient magnitude to wipe off the additional expenditure in the course of a few years. For instance, it will be found that at the present time a good type of 10,000 ton (deadweight) motorship designed for 10½ or 11 knots at sea will cost between £130,000 and £140,000 whereas a steamer can be obtained for about £100,000. Therefore, there will be little advantage to the shipowner in employing oil engined vessels unless he can be assured of a saving in operating expenses of at least £3,000 annually. Indeed, this amount would scarcely be a sufficient inducement for adopting the motorship.

The Shipping Board has in its possession a large number of vessels having good hulls in which inefficient propelling machinery is installed. These ships are of no value as they are but they may be converted into first class motorships under the plans now being developed by Admiral Benson at a cheaper cost than similar vessels could be constructed anywhere else in the world. The difference in first costs between steamers and motorships and the fixed charges thereon have been the principal reasons why motorships have not been developed to a greater extent in this country. But now that good hulls are available for conversion at a price reported to be between $5 and $10 a ton shipowners have an opportunity that will never be repeated to acquire vessels that will save them money by materially decreasing their fuel bill and by increasing their freight revenue through larger carrying capacity.

Fuel Consumption Records

In order to elucidate this problem some tables have been prepared to show the fuel consumption of various types of ships. These details, which are given below, relate to the average speed and daily fuel consumption obtained over long periods, in many cases representing a series of voyages up to a total of 100,000 miles, or two years' operation. In no case are they given for merely short runs or are they the results obtained on trials, and it is a notable fact that in practically every case, the amount of fuel required after a year or two's service is found to be somewhat lower than when the vessel is first placed in commission.

The next table gives a comparison between a steamer and a motorship of almost identical size, tonnage and speed. The figures relating to the steamer are official and are extracted from a paper read in March before the North East Coast Institution of Engineers and Shipbuilders.* This steamer is one of the most economical type afloat, being fitted with steam turbines and double-reduction gearing. A boiler pressure of 200 pounds per square inch is used, and the steam is superheated to 200 degrees Fahrenheit. An ordinary reciprocating engined vessel would have

*"Notes on the Economical Performance of Turbine Installations in Merchant Ships" by T. G. Potts.

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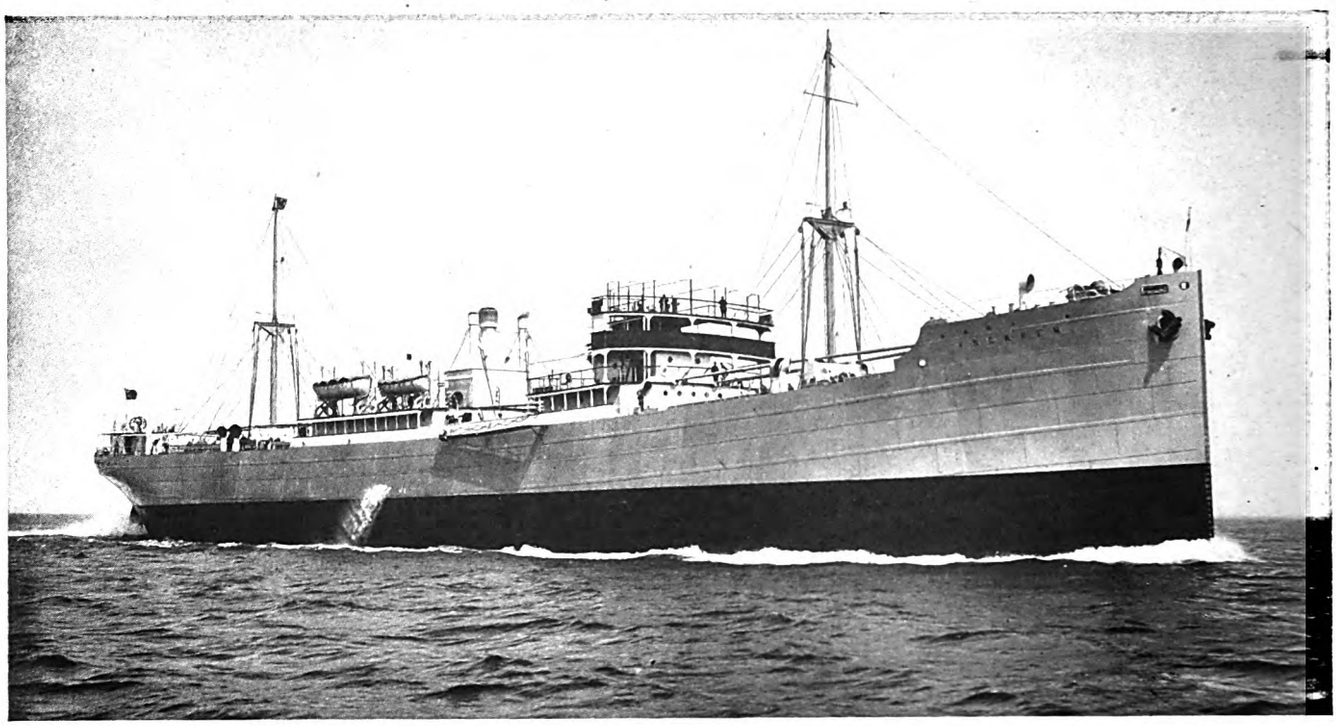

Single Screw Cargo Motorship Yngaren, of 9,350 Tons Deadweight, Built and Engined by William Doxford and Sons for Transatlantic Steamship Company, of Gothenburg

a fuel consumption approximately 15 percent higher and, the result given probably represents the best that can be obtained with a steamship of this size. The average speed and consumption relate to 16 voyages, totaling about 50,000 miles.

The motorship, with which comparison is made, is the *Yngaren* and the figures are those given by Mr. Madsen, the superintending engineer of the Transatlantic Company (the owners of the vessel) in a paper before the Institute of Marine Engineers.† In this case, also, the results are those over a number of voyages of long duration.

It will therefore be seen that with the most efficient steamer afloat, the amount of coal consumed is 3½ times the oil required for a motorship of the same size and slightly higher speed. We may therefore assume that with the average class of steamer the amount of coal required is quite four times the oil burned in the Diesel engines of a motorship. It should, perhaps, be added that in this motor vessel bunker oil is utilized, of the same grade as that burned under boilers.

Comparison of Fuel Costs

The *Yngaren* takes on her oil at the Panama Canal, where the cost is about £2 per ton, giving a daily fuel bill of £21.12.0. The average price for coal throughout the world is about £2 per ton, giving a fuel bill for the steamer of £75.8.0 and showing a saving of £53.16.0 per day in favor of the motor vessel. Even allowing for bunker coal obtained at 30/- per ton, (which is nearly the lowest possible price) the steamer's fuel bill will be £56.12.0 showing a saving of £35, or between £8,500 and £9,000 per annum.

If we make the comparison between oil fired steamers and motorships, the results are equally striking. Some time ago, the Fuel Conservation Committee was authorized by the United States Shipping Board to carry out some trials on the oil fired steamer *President Polk* and her sister ships. These vessels are 502 feet between perpendiculars with a beam of 62 feet, and it was found that the average results showed a speed of 13.9 knots on a daily oil consumption of 89.6 tons.

There are about a dozen motorships of approximately the same size and speed now in service, such as the *Glengarry* owned by the Glen Line and the *Lochkatrine* and *Lochgoil* operated by the Royal Mail Steam Packet Company. Over long voyages, the daily fuel consumption of these vessels works out at 21 tons with a speed of 13 knots. Admittedly this is a somewhat lower speed than that of the *President Polk* but the amount of oil consumed is actually less than one fourth of that required in the steamers.

Fuel Costs at Current Prices

It will be agreed from the figures given in the first table that a 10,000 ton motorship with a speed of 10½ or 11 knots will have an average daily consumption of not more than 10½ tons. A corresponding oil fired steamer burns about 30 tons daily. Accepting these figures, an interesting comparison can be made between fuel costs of the two classes of ship, at current prices for fuel oil and Diesel oil.

†"Internal Combustion and Economy," by Tage D. Madsen.

FUEL CONSUMPTIONS OF MOTORSHIPS

Motorship	Deadweight, Tons	Aver. Speed, Knots	Daily fuel Consumption, Tons
Bullaren	11,000	10.8	10.90
Falstria	7,500	10.0	8.00
Buenos Aires	9,400	11.0	10.50
Glengyle	10,000	11.5	10.30
Glenavy	10,000	11.5	10.68
Lobos	10,000	10.6	10.30
Glenlucc	10,000	10.0	10.60

COMPARISON BETWEEN A STEAM AND MOTOR SHIP

	Double Reduction Geared Turbine Vessel, 200°F. Superheat	Motorship *Yngaren*
Length	425 feet	420 feet
Beam	55 feet	54 feet
Load draft	25 feet 6¼ inches	25 feet 6 inches
Gross tonnage	5,494	5,247
B.H.P. at sea	2,750	2,700
Speed, knots	11.12	11.2
Fuel Consumption per day, tons	37.7 (coal)	10.8 (fuel oil)

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Taking New York as the bunkering port, the quotations for fuel oil and Diesel oil, at the time of writing, are respectively 42/- and 53/- per ton. This gives a daily fuel bill of £64.10.0 for the steamer and £27 for the motorship. In London, the corresponding prices for oil are 65/- and 80/- per ton, so that a steamer bunkering at London would have to pay £97 for its fuel per day, against £42 for the motorship. A coal fired steamer would burn not less than 38 tons daily, and with bunker coal at 32/- and 35/- per ton at New York and London respectively, the daily fuel bill of a vessel bunkering at one or other of these ports would be £61 and £67.

It would seem from these facts that, at any rate for average cases, the additional expenditure on the motorship is well warranted. Each case must necessarily be analyzed on its merits, but it must always be remembered that, owing to its wide radius of action, the motorship can carry sufficient fuel in double bottom tanks for very long voyages and is thus able to choose the port at which it will purchase fuel. In other words, the motor vessel has better opportunities for obtaining a cheap supply than either the oil fired or coal fired steamer.

MOTORSHIP CAN CARRY MORE FREIGHT

Even when a good margin is allowed in this respect, the motorship is still able to carry a larger freight than the steamer owing to the reduced weight of the fuel and this is, of course, particularly noticeable in the case of comparisons with a coal fired ship. This fact must not be lost sight of when comparing the prices of steamers and motorships of the same dimensions.

It may be added that in connection with a 22,000 ton motor liner which is now being built by the Fairfield Company for the Union Steamship Company of New Zealand, Mr. Traill, the engineering manager of the building firm, stated that owing to the adoption of internal combustion machinery the passenger accommodation has been increased 18 percent beyond that which would be possible on a steamer of the same size and speed.

It may be asked whether the economies outlined above are not offset to some extent by a larger repair bill in the case of the motor vessel. It may definitely be stated that this is not the case, and that the average motorship has a repair bill little, if any, higher than that of the reciprocating engined vessel and probably a good deal lower than the cost involved with a geared turbine ship.

No better instance of this can be afforded than the results which have been publicly announced concerning the operation of the *William Penn,* the repair bill of which, for a whole year's service, only amounted to something like $100.

British Shipyards Get String of New Contracts

Individual Shipowners Going Ahead—Both the Shipbuilding and Shipbreaking Outlooks Are Getting Much Brighter

By W. H. Wendon

THE past month has been characterized by a remarkable divergence of opinion as to whether the shipping depression has really touched bottom, or whether that desirable condition has yet to arrive. One is, indeed, tempted, at the risk of being dubbed "slangy," to express the conviction that shipowners—and in this connection I include shipbuilders and engineers—in the words of the popular song: "Dunno where they are." Whatever the immediate or distant future may hold, however, there is no denying the fact that shipping has of late received a decided fillip as regards coal exports, but, so far as one is able to judge, this is almost entirely due to the stoppage of German mining on the Ruhr, following the occupation by the French. This branch of the carrying trade is, therefore, experiencing a "boom" time—at the moment; but the experts are generally agreed that, as soon as reconciliation is reached on the Ruhr, the inrush of coal orders will be suspended, with a consequent relapse in the shipping trade. Briefly, then, the effect of the Ruhr situation has been to create a sudden artificial demand to fill the gap left open by the cessation of production in the great German coal area. The result has been an abnormal rise in the price of British coal, and the advantages accruing to ship owners have been to some extent offset by the increased cost of bunkers.

IS IT TIME FOR SHIPOWNERS TO ORDER NEW VESSELS?

The principal point of discussion between shipowners and shipbuilders at the moment, however, is in regard to the question. Have shipbuilding costs fallen to an irreducible minimum? Accordingly, can shipowners now step in and order vessels whereas formerly they had to tread warily in this vital matter? Mr. J. C. Gould, who occupies the rather unusual position of being shipowner, shipbuilder and engineer, believes beyond the shadow of a doubt that the end of the shipping depression has been reached, that, in fact, it has been passed, and that the shipping trade is now on the upward trend as regards cheaper constructive costs. Wages, he feels, cannot be further reduced, and he is convinced that the price of steel can go no lower. Summed up, therefore, his conviction is that shipowners are only wasting time if they now refrain from ordering new tonnage.

Without for one moment attributing to Mr. Gould the art of being two-faced, one has obviously to bear in mind that, in expressing his views in this manner, he may be—I do not suggest he is—obsessed by the knowledge that he is a shipbuilder, and, therefore, that from the point of view of a shipbuilder, the educating of shipowners into a contracting frame of mind is by no means undesirable. Anyhow, time alone can prove the correctness of his forecast that pronounced improvement in trade is only a few months off. Incidentally, Mr. Gould is not alarmed at the possibility of America throwing seventeen hundred ships on the market, because, in his opinion, "half these ships could never be operated, and the balance would never be operated at a profit."

In contrast to Mr. Gould's optimistic utterances, it is interesting, if not instructive, to note that Mr. Lawrence Holt, a director of the Blue Funnel Line (Messrs. Alfred Holt and Company, Liverpool), speaking at the launching of the twin-screw geared turbine steamer *Patroclus,* placed in the water for his company, stated that he regards this vessel not as a commercial proposition, but as representing an act of faith in the future, she having been built out of the profits of the past in the hope that better times will come. Mr. Holt appreciates what shipbuilders have accomplished in the matter of reducing costs of construction, but says that, even at present reduced costs, shipbuilding cannot possibly flourish. His

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views are, therefore, in direct contradiction to those of Mr. Gould, who, as I have indicated above, considers that it is out of the question for shipbuilding costs to be further reduced.

Diesel Engine Prices Will Have To Be Reduced

Sir Walter Runciman, chairman of the reorganized Moor Line (the original Moor Line, it will be recalled, was voluntarily wound up after distributing a handsome return to the shareholders consequent on the sale of the fleet at "boom" values), is more than a little inclined to draw the same conclusions as Mr. Holt, for the Moor Line is ready to give more orders when, in the opinion of Sir Walter Runciman and his co-directors, "prices come again to an economic level." The Moor Line directors, be it added, have also come to the conclusion that the original price of Diesel or other internal combustion engines will have to come much nearer the price of steam engines before they can regard the change as commercially justified.

Ship Breaking Outlook Brighter

Apropos the general shipping situation, the question of scrapping obsolete or semi-obsolete merchant vessels is again to the fore, and, as was the case two years ago, the prime mover in the discussion is Lord Kylsant, better known, perhaps, as Sir Owen Phillips, which was his title until he was recently elevated to the peerage. When Lord Kylsant, in his then capacity of President of the Chamber of Shipping of the United Kingdom, broached this subject two years ago, he urged the necessity of shipowners doing everything in their power to revive the ship breaking industry, which during the war had passed out of existence, consequent on every vessel, whatever her age or character, being required to offset the effects of the submarine sinkings.

Two years ago, however, the cost of breaking up a vessel was greater than the value of the material when scrapped. Lord Kylsant was then, as he himself describes it, thought to be "speaking in the wilderness," but times have changed, and it is understood that this old trade is now reviving, if not in the United Kingdom, at least in other countries. A beginning has already been made in the breaking of vessels, but the presence in harbors all over the world of idle vessels of varying ages and in doubtful condition is obviously a factor on which the adherents of the break-up policy wish shipowners generally to ponder.

High Book Values Prevent Scrapping

It is a fact, however, that, although there is, under the British flag, a large amount of tonnage which, by reason of age, must be considered as fit for the scrap heap, there is very little offering for sale to ship breakers. The reason, however misguided, is not far to seek: It lies in the fact that the many boats acquired when prices were high still stand in the shipping companies' books at enormous figures, and the owners are not unnaturally reluctant to sell the vessels at knock-down prices, thus automatically writing off vast capital sums. They prefer, at all events for the present, to hold the vessels in the hope that the not too distant future may produce a general "boom," if only in miniature, when their losses would be mitigated.

String of New Contracts Placed

It must not be imagined from the foregoing paragraphs that the air of gloom pervading the shipping atmosphere has dispelled the desire of shipowners, as individuals, to augment their fleets. Indeed, the reverse is the case. The past month has seen the placing of a string of new orders, ranging from large motor liners to the humble coaster. Major interest, perhaps, attaches to the contract placed by the Swedish-American Line, of Gothenburg, with Sir W. G. Armstrong, Whitworth and Company, of Newcastle, for a motor liner of 17,000 tons gross, and to have accommodation for 1,600 first, second and third-class passengers.

This vessel, which is intended for the company's passenger and cargo service between Gothenburg and New York, will be propelled by twin-screws driven by double-acting four-cycle motor engines of an entirely new type, developing 13,500 shaft horsepower, and intended to give the vessel a speed of 17¼ knots. The motors, which are the first of this type to be built, will be delivered by Messrs. Burmeister and Wain, of Copenhagen, and are considered to be the greatest advance in Diesel engineering hitherto entered upon.

Then, Messrs. Vickers, of Barrow, have received from the Donaldson Line, of Glasgow, an order to build a cargo and cattle liner, to have a length of 400 feet and to carry nearly 8,000 tons of cargo. There will also be provision for several hundreds of store cattle. This boat will operate between Liverpool, Glasgow and Canadian ports, and will be propelled by internal combustion engines of the Vickers' standard patent four-cycle solid injection type, developing about 3,000 horsepower upon a single shaft. This Donaldson liner will, when completed, be the first Diesel cattle and cargo liner on the North Atlantic.

Japanese Contract for Motorships

Other vessels to be built include two motor cargo boats, each of about 10,000 tons deadweight, contracted for by the Nippon Yusen Kaisha. One is to be built by Messrs. Harland and Wolff in their Govan (Glasgow) shipyard, and the other by Messrs. Lithgows, of Port Glasgow. The Furness Shipbuilding Company, of Haverton Hill, are to build a cargo liner of 8,000 tons for London shipowners. She is to be fitted with Diesel engines of the Sulzer type by the Wallsend Slipway and Engineering Company. The designed power is 1,800. Messrs. Andrew Weir and Company, of London and Glasgow, have ordered three cargo vessels from Messrs. Harland and Wolff, of Govan. They will have internal combustion engines, constructed at Messrs. Harland and Wolff's Diesel engine works at Glasgow. Messrs. William France, Fenwick and Company, Ltd., London, have ordered four steamers of about 3,300 tons each, two from Messrs. Vickers and two from Sir James Laing and Sons, Sunderland. The Blythswood Shipbuilding Company, Glasgow, are to build two cargo steamers, of 8,000 tons deadweight each, for Messrs. R. S. Dalgliesh, Ltd., Newcastle. The contract price is stated to be £9 per ton. Messrs. William Cory and Son, London, have ordered a 3,400-ton deadweight self-trimming collier from Messrs. Swan, Hunter and Wigham Richardson, Newcastle, and Messrs. Barclay, Curle and Company, Glasgow, are to build a large cargo vessel, to be fitted with double-acting Diesel engines, for London owners. Last, but not least, Mr. William L. Roxburgh, of the Coast Lines, Ltd., Liverpool, has contracted for four steamers of 250 feet in length, and is stated to be about to place contracts for a further sixteen vessels of this size, in addition to a large cargo steamer. In analyzing the above list of new contracts it is as well to bear in mind that the owners concerned are not of the "mushroom" type—here to-day and gone to-morrow—but in nearly every instance are old-established firms or companies. It is safely to be inferred, therefore, that they at least have a certain amount of confidence in the future.

Losses on American Ships Due to Fire.—The United States Steamboat Inspection Service in its yearly (1921-1922) report shows that 21.4 percent of last year's marine property losses on American ships were due to fire. Consulting their previous reports the toll paid to fire during the past eleven and one-half years amounted to 13.4 percent of all property losses. Excluding our war years in which other losses were abnormal the remaining period charges fire with 15.7 percent.

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Fourth British Built Motor Passenger Liner Fitted With Diesel Engines Just Commissioned

New Vessel Is Similar to Steamers Owned By Same Company, Giving Excellent Opportunity for Valuable Economic Comparisons

By Our London Correspondent

THE development of the motor passenger liner has been one of the most interesting features in British shipbuilding during the past few years. There are now three oil engined passenger ships in regular service, and although they are not of very large size, the satisfactory nature of their performance has led to orders being placed for motor liners up to over 20,000 tons-gross.

A fourth vessel of the same class has just been commissioned. She is named the *Dumana,* and was built on the Clyde by Barclay, Curle & Company for the British India Steam Navigation Company for their passenger and cargo service between London and Bombay.

She is what may be termed an intermediate class of ship with a speed at sea of just under 13 knots, a cargo carrying capacity of about 11,000 tons, and accommodation for between 130 and 140 first and second class passengers. The three previous liners which have been referred to are the *Adda* and the *Aba* (vessels of 9,000 tons-gross with accommodations for about 330 passengers, engaged on the run between Liverpool and the West Coast of Africa) and the *Domala,* which is very similar to the *Dumana,* and was built for the same owners.

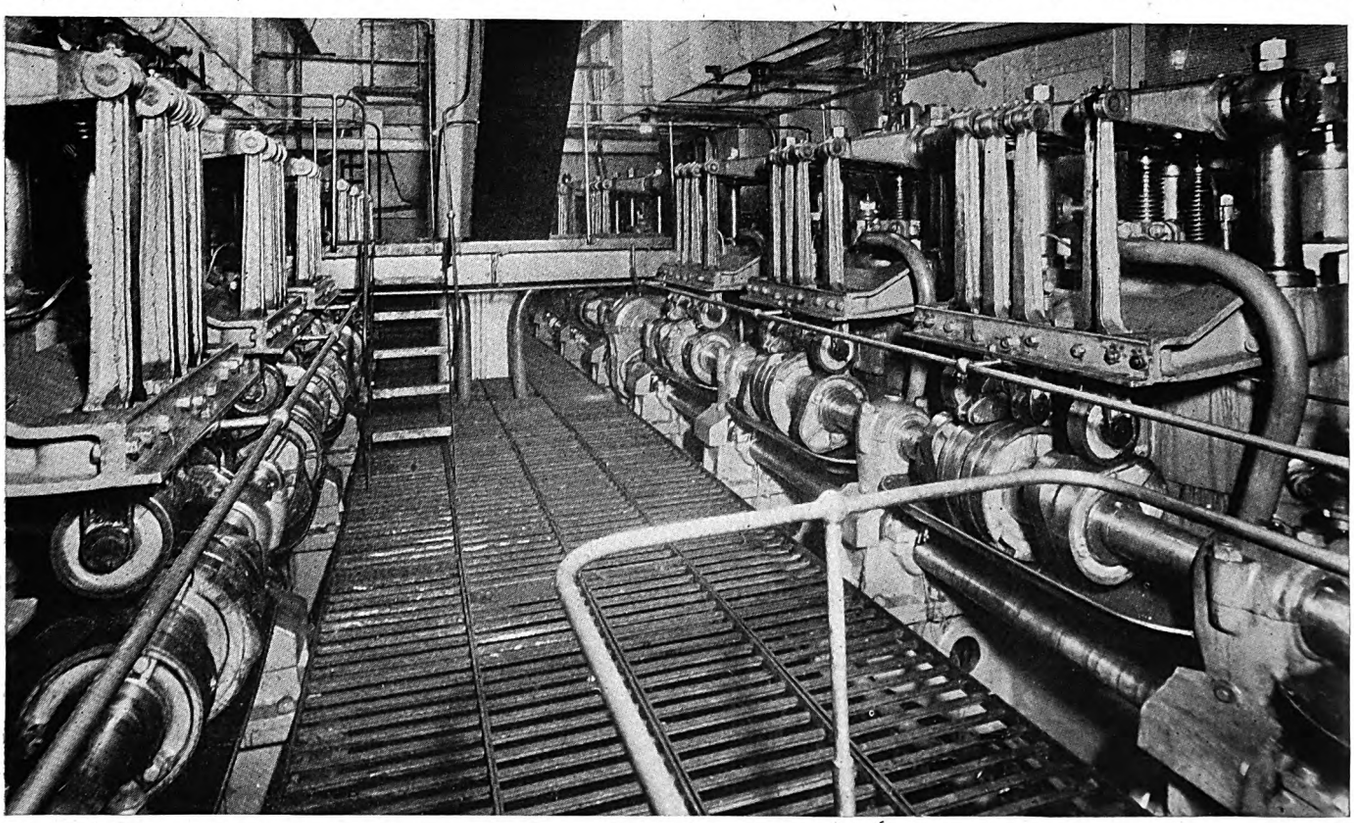
Electric Winches Used

Apart from her machinery, the *Dumana* is a type of ship well known to travelers to the East. The cargo is carried in three holds forward of the engine room and three aft, served by twelve electric winches, some of three tons' capacity and the others of seven tons.

It is noteworthy that in the majority of the more recent European motorships, electricity is used for operating the winches, as well as for most of the auxiliary machinery in the engine room. Admittedly, this adds somewhat considerably to the first cost, while the weight of the plant is higher than when steam machinery is employed. Nevertheless, the economy in fuel is so large that when ship owners have had experience with both electrical and steam auxiliaries, they seem invariably to prefer the former type. It is stated, for instance, that on the *Dumana* only one-tenth of the amount of fuel will be used for the auxiliaries as compared with that required if the whole of the plant were steam driven.

Striking Fuel Comparison for Similar Ship

The saloons and passenger cabins in the new ship are arranged on exactly the same lines as in a corresponding steamer. Incidentally it may be mentioned that the owners have several vessels of the same class equipped with reciprocating steam engines and geared turbines. The coal consumption of these vessels usually averages about 70 tons daily, while when oil firing is utilized, the amount of fuel needed is 45 tons. Against this, the motor liner of the same dimensions and slightly higher speed consumes between 17



Motorship Dumana, Top Platform Showing Valve Gear

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Motorship Dumana, Starting Platform Looking Forward

and 20 tons of oil daily for all purposes, the former figure being usually attained on normal runs.

The passengers are berthed in cabins on the upper and bridge decks. Normally there is accommodation for 88 first and 41 second class passengers, but as is usual with the British India Steam Navigation Company's vessels of this class, some of the cabins can be altered so that the number of first class passengers carried may be increased or diminished as required. They are mainly two and three berth cabins, all arranged with direct access to the side of the hull, so as afford natural lighting in each room. At the forward end of the upper deck is the dining saloon with a large number of small tables, and at the after end is the second class dining saloon. Forward of the promenade deck is a first class music room and a separate smoking room, while aft is the second class smoking room. Officers and engineers are both berthed on the boat deck, the latter being at the after end. This system of having the engineers and officers on the same deck was one of the innovations of the British India Steam Navigation Company, some years ago, and is now very popular.

Main Propelling Machinery

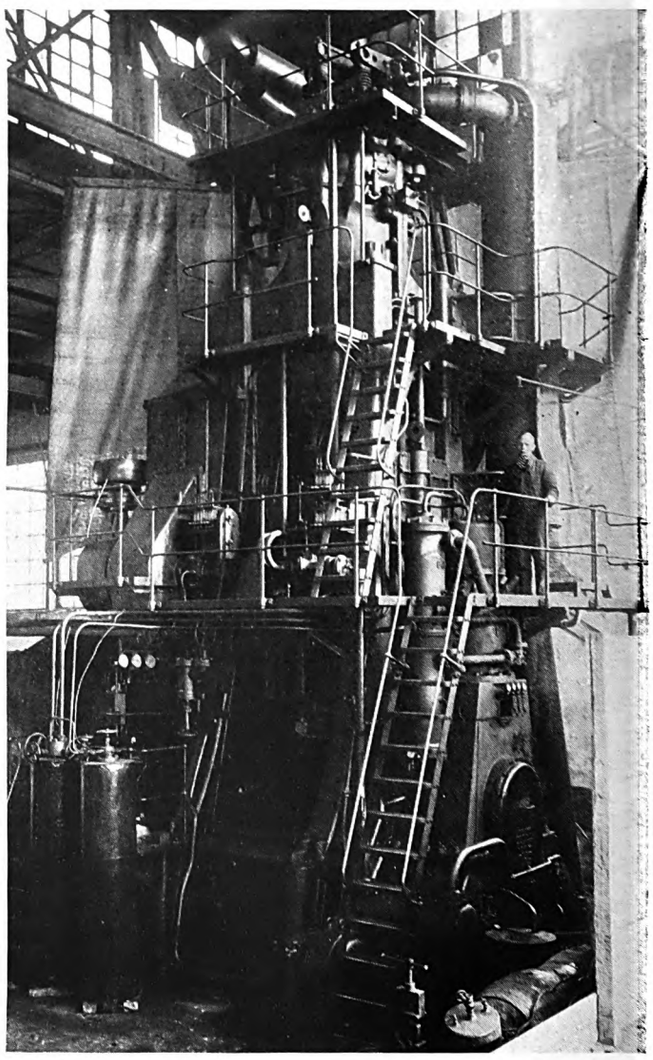
For propulsion, two four-cycle Diesel engines are installed. These are of the eight cylinder type constructed by the North British Diesel Engine Works and are of their own design, developed after the war. Each engine is rated at 2,330 indicated horsepower at 96 revolutions per minute and this is roughly equivalent to 2,000 steam indicated horsepower. There is little that is novel in the construction of these engines, which drive their own high pressure three-stage air compressors, but no other auxiliaries. Although separate piston cooling and jacket cooling pumps are provided, sea water is used for both purposes, the pressure in the case of the piston cooling circuit being of course higher than that used for cooling the cylinders.

As the *Dumana* is liable to enter rivers which are extremely muddy and there is a possibility of a considerable amount of deposit being drawn through the circulating system, arrangements are made whereby the piston cooling pumps draw the sea water through a special tank provided with filters. The main reason why some Diesel engine manufacturers (as, for instance, Harland & Wolff) employ fresh water cooling for the pistons is because of this danger of muddy water and not on account of the possibility of salt being deposited in the cooling spaces in the pistons as is sometimes imagined.

The arrangement of the auxiliary machinery in a motorship affords an interesting study, since each individual builder seems to have a different idea of the needs of the case from that of other manufacturers. As previously mentioned, electricity is used for practically all purposes on the *Dumana* and the supply is derived from two generating sets, each of 215 kilowatts and driven by a six cylinder engine running at about 375 revolutions per minute—a rather high speed for marine work. The voltage of supply is 220, as usual, and this is used both for lighting and power, whereas on most Scandinavian motorships, a rotary converter is installed reducing the pressure to 110 volts for lighting.

Most British builders are in favor of having a high powered maneuvering air compressing plant, and the *Dumana* affords an excellent example of this tendency. There are two auxiliary three-stage air compressors; one is coupled to an electric motor developing 250 brake horsepower, while the other is driven by a six cylinder Diesel engine of the same power as that coupled to the two electric generators, namely 300 brake horsepower. The total power for driving these auxiliary compressors is therefore no less than 550 brake horsepower which certainly seems somewhat heavy on a vessel where the propelling plant develops well under 4,000 brake horsepower.

On the trials, a speed of approximately 13½ knots was attained.



Single Cylinder, Double Acting, Four Cycle 1000-Brake Horsepower Experimental Diesel Engine Built by Burmeister and Wain and Operated for Four Months in Their Experimental Shop at Christianshavn

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Study Insurance Problems to Prevent Losses

By "Bordereaux"

Marine insurance is one of the greatest economic factors in the shipping industry. Without it ocean commerce could hardly exist. It is a guaranty against loss from legitimate sea perils, many of which are unpreventable. Pilferage, unseaworthiness, overloading and nefarious practices, however, can be reduced to a minimum not only lowering the cost of insurance but in many cases preventing total losses; for the courts do not always decide against the underwriters.

RESPONSIBILITY of carries for pilferage losses is pressing again to the fore. There seems to be something of a revival in this class of depredations. Merchants are complaining of rifled cases in practically every trade route, and especially as regards Mexico and South America. The Mexican situation is particularly bad. Investigations by underwriters have uncovered a serious condition at Vera Cruz and other ports in Mexico, everything pointing to a systematic conspiracy on the part of customs authorities at Vera Cruz and unscrupulous merchants at Mexico City to rob merchandise while in transit through the customs.

Chile has produced the latest device designed to curb theft and pilferage, the plan being to place on ship captains the responsibility for missing or underweight packages. United States Consul George A. Makins, at Valparaiso, refers to it in his recent reports. He says: "The Chilean customs ordinance (Art. 89, Paragraph 3) provides that a fine may be imposed on the captain of the vessel where cases are found to have been opened or their contents removed without the written permission of the customs authorities. In a recent case at Valparaiso, where it was found that 460 parcels of cargo had had their contents stolen before being discharged, a fine of 5 pesos per package was imposed on the captain of the vessel. The steamship company moved for dismissal, arguing that this was a distortion of the intent of the law. The decision was contested and brought before the Chilean Supreme Court, which upheld the original decision and ordered the captain of the vessel to pay the fine."

Importance of Dunnage

ACCORDING to a recent decision of the United States District Court, S. D., New York, 285 Fed. Rep., 612, under the Harter Act ship owners are under obligation to furnish seaworthy vessels, and grain-carrying ships must be properly dunnaged to protect cargo from water damage. This was a suit in admiralty brought by the Midland Linseed Products Company against the schooner *Oakley C. Curtis* and the France and Canada Steamship Corporation, on a libel to recover $146,000 damages to a cargo of linseed transported from Buenos Aires to New York. The court ruled against an extension of the Harter Act as contended by the respondents to the effect that they warranted the seaworthiness of the vessel in so far only as ordinary care can provide and that the vessel was relieved only from liability arising from an act of God, perils of the sea, etc. It was shown that the hull was entirely seaworthy but that the trouble lay with the dunnage, which was improper and insufficient.

In the matter of dunnage it was proven that the pieces of boards used for sealing the sides of the vessel had no protecting sidepieces, as they should have had, and that the boards were spaced too far apart, with the result that many linseed bags pressed or pushed into the spaces and against the ceiling or skin of the ship. The consequence was that the bags and their contents in the lower hold were wetted during the heavy seas that prevailed. Furthermore, air strakes and spaces between the beams extending into the bilges were not securely covered, as they should have been, and loose grain was, on that account, enabled to sift to the bilge between the timbers of the vessel, clogging the pumps and preventing the pumping out of the hold. As to water coming in at the sides, the respondents were deemed liable for damage from this source, since it was shown that if the 'tween-deck and the lower hold had been properly sealed or dunnaged the water would have passed into the bilges and would have been pumped out.

Lightning a Sea Peril

A WEEK or so ago the steamer *Albania* arrived in New York with word of having narrowly escaped being struck by lightning while in mid-ocean, and the consequence has been a revival of the perennial question "Is Lightning a Sea Peril?" Oddly enough, there appears to be doubt in many quarters as to the propriety of including lightning among perils of the sea, the argument being that lightning is no more such a peril than rain and that there is nothing of an extraordinary character to it and that it is in no wise peculiar to the sea. In this connection it is interesting to recall the views of the Supreme Court of South Carolina, in the recent case of the Clinchfield Fuel Company vs. the Ætna Insurance Company, as regards the meaning of perils of the sea.

This was an action brought by the fuel company against the insurers to recover for the loss of a cargo of coal shipped per steamer *Northwestern* from Charleston, S. C., to Cuba. The vessel was of wood, built in 1881 and twice rebuilt. On the passage she encountered heavy winds and cross seas, and on the third day out she was beached in order, if possible, to save the crew and cargo. She soon broke up, however, and with the cargo was a total loss. In the course of his opinion the presiding judge observed of the term "perils of the sea" that it is a phrase interpreted with great strictness in connection with bills of lading but with surprising elasticity where the assured is claiming a recovery under a policy of insurance. Such a variance of interpretation the judge admitted to be erroneous, but he held that in any event the term must be interpreted with considerable elasticity when applied to policies of insurance. The court cited authorities to show that even though a storm was not so extraordinary as to have resulted from uncommon causes yet it was unnecessary to show such a storm in order to have a claim under the perils of the sea clause in a marine insurance policy. Thus Carver, in "Carriage by Sea," says: "Upon this it must be remarked that losses need not be extraordinary, in the sense of arising from causes which are uncommon. Rough seas, which are characteristically sea perils, are common incidents of a voyage." The court quoted from the case of The Hazard vs. Peters, wherein it was held that "they (the underwriters) insure against losses from extraordinary occurrences only, such as stress of weather, winds and waves, lightning, tempests, rocks, etc."

While on the question of "perils of the sea" it may be well to recall the admirable working definition of this mooted phrase as given in the decision of Judge Hough, Circuit Court of Appeals, in the *Rosalia* case, 264 Fed. Rep. 285.

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He therein stated that "a peril of the seas which forms a good exception in a bill of lading means something so catastrophic as to triumph over those safeguards by which skillful and vigilant seamen usually bring ship and cargo to port in safety."

Barge Canal Outlook

UNDERWRITERS and shipowners are finding much to interest them in the current news of activity as respects business on the New York State Barge Canal during the present season. All indications point to an extended use of the canal by shippers in the Middle Western States. According to Superintendent of Public Works Walsh, financial interests at Cleveland, Detroit and Duluth have under consideration a considerable investment in equipment to be used on that waterway and on the Great Lakes. Contracts have already been let by one group for two Diesel-engined, electrically-driven motor ships, each capable of carrying two thousand tons of freight on the canal draft, and it is expected that they will be ready for use by midsummer. Crude rubber importations will probably be carried by the canal to Cleveland and thence by rail to Akron, at a saving of $2 per ton over the all-rail rate, provided adequate terminal facilities can be effected at Cleveland. Import flaxseed for Cleveland and Toledo will probably be resumed by way of the canal, running into hundreds of thousands of tons. Holland building brick is another commodity that will probably be moved to the Western market from New York via the canal.

Transshipment Problem

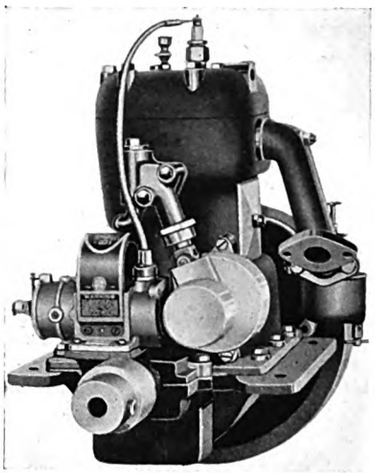
THE collapse of the Three Star Line has brought an embarrassing situation upon the underwriters, especially as regards the problem of a transshipment of cargoes now tied up at various points. Three of the company's steamers are now detained at widely separated ports—the *Bacchus* at Marseilles, the *Phoebus* at Philadelphia, and the *Janus* at Oran, Algiers. Urgent questions have developed in connection with the insurance carried on their cargoes, and responsibility for getting the merchandise forward to destination. On account of the financial condition of the line these cargoes have been discharged and await the further instructions of the shippers who own them. Such a situation naturally entails enormous expense upon the shippers, the freight having been prepaid and the merchandise lying scattered at remote points. No sea peril is involved and claims on that account are not entertained. Responsibility for transshipment, under ordinary circumstances, would devolve upon the carrier, but in the conditions of the present case it will have to rest with the owners of the cargoes. As regards the validity of the insurance, the majority of the underwriters concerned are maintaining that an abandonment of voyage has occurred, and that extended coverage must be applied for by the insured and secured by the payment of additional premium.

Overloading

IT is universally admitted that overloading constitutes a factor of decided danger to ship and cargo. Recent instances of it have been occasioning underwriters considerable anxiety; to such an extent, indeed, as to arouse consideration of the introduction of a clause in policies under the terms of which the policy must be warranted free of any claim incurred during a voyage on which the vessel sailed in an overloaded condition. This has been directly the outcome of repeated warnings to the effect that foreign steamers have been sailing regularly from the River Plate with cargoes of grain loaded to a depth that submerges their load lines at least by a foot. There is nothing in the hull policy, unfortunately, to prevent an owner from overloading his vessel. In the event of a loss in consequence, the underwriter is forced to pay the bill. It will be generally admitted that something ought to be done, by underwriters if others will not take the lead, to put an end to a practice that is the outgrowth of greed and which imperils the lives of the crew and jeopardizes ship and cargo.

Marine Motor for Small Boat Propulsion

A SMALL size, low price motor, having a special feature of interchangeable parts standard to Ford motors, is being built on a quantity basis by a recently organized corporation of Detroit, the Du Brie Marine Motors. This motor is a single cylinder four-cycle 5 horsepower type weighing 100 pounds. It is equipped with a Bosch high tension magneto, an impulse starter, a Holley carburetor and propeller wheel. This motor is also equipped for twin-screw installation with either right or left hand rotation. Forty-four of the parts of the Du Brie marine motor are interchangeable with the standard parts of the Ford automobile engines, thus making possible replacements at a minimum cost.



Du Brie Marine Motor

It is claimed that this motor is very flexible, due to the hot spot manifold and a special type camshaft. It has been demonstrated that the motor may be slowed down to 180 revolutions per minute and run at this speed indefinitely. Arrangements have been made with Chris Smith and Sons Boat Company of Algonac, Mich., builders of racing craft, to furnish plans and specifications for a 25-foot boat specially designed for use with this motor. These plans are furnished with each motor upon request.

Liability of Vessels Sold by Government

IN the case of the Texas Company vs. United States, 285 Federal Reporter, 643, a libel was filed against the *M. Morgan*, previously known as the *Retriever*, to recover damages for a negligent collision. At the time the cause of action arose the vessel was owned by the United States but was subsequently sold. The Court held, that the provisions of the Suits in Admiralty Act of March 9, 1920, section 5, which states that suits thereunder on causes of action arising prior to its taking effect must be brought within one year after it went into effect, does not apply to a suit in rem authorized by the Act of September 7, 1916, (Comp. Stat. sec. 8146a, etc.) against a vessel which has been sold by the government, and for which the United States assumes liability under sec. 4 of the Suits in Admiralty Act.

The Spring meeting of the American Society of Mechanical Engineers will be held in Montreal, Canada, May 28 to 31. The Engineering Institute of Canada will attend the meeting.

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Current Admiralty Decisions of Special Interest

By Calvert B. Gill*

Maritime Contract With City Binding

A MARITIME contract with a city for the unloading of a sunken scow, says the Court in Rodgers & Hagerty, Inc., vs. City of New York, 285 Federal Reporter, 362, can be enforced in a court of Admiralty without regard to the provisions of the city charter limiting its liability on such contracts, since the enforcement of those provisions of the charter in a court of Admiralty would destroy the uniformity of the Admiralty jurisdiction that is preserved by the Constitution of the United States.

Damages Occurring on Dock Outside of Admiralty Jurisdiction

THE seeking to recover damages arising from a tort which occurred on a dock at which a vessel is moored, as the plaintiff endeavored to do in the case of Spitzer vs. the *Annette Rolph,* 285 Federal Reporter, 446, the Court says is without the pale of Admiralty cognizance so that the exclusive jurisdiction of Admiralty is not invaded by bringing such action in a State court, and the cause is not removable to a Federal court on that ground. A vessel is not a "citizen within the purview of the statutes authorizing removal of causes to the Federal courts, so that a cause instituted in the State court by a citizen of the State against a vessel, whose home port was in another State cannot be removed on the ground of diversity of citizenship.

Enforcement of Maritime Liens Where Common Ownership Exists

THE fact that the corporation furnishing supplies to a vessel and the corporation owning the vessel had largely the same stockholders and many of the officers were identical does not make the supply corporation a part owner of the vessel, nor indicate the supplies were furnished on the credit of the owning corporation, if the managing officers of the two corporations, by whom the supplies were sold and purchased, were different and there was no showing that the supply corporation had used its relationship to compel the vessel to purchase supplies from them.

A maritime lien is denied to a party, who would otherwise be entitled to it because of his relation to the vessel, only when he is either a real part owner of the vessel, occupies a fiduciary relation toward her and her owners or deals with himself on her account; that is, the lien is denied because of insuperable legal difficulties in the enforcement of it, or because to recognize it would be inequitable to the other claimants, says the Court in the case of the *Gloucester,* 285 Federal Reporter, 579.

Obligation of Owner to Provide Dunnage

THE *Oakley C. Curtis,* 285 Federal Reporter, 612, is a libel to recover damages to a cargo of grain damaged by sea water while in transit. The Court said: "It is well established that a vessel beginning her voyage in a time of year when storms at sea are prevalent, carrying grain, must install dunnage, so as to keep the cargo free from water which may reasonably be expected to enter during the voyage from strains and stress of weather or other leakage." The Harter Act. Sec. 3, does not exempt the owner of a chartered vessel from the obligation to furnish a vessel which is seaworthy and fit for the cargo to be carried at the commencement of the voyage.

Offer of Re-instatement Annuls Wrongful Discharge

A PROMPT offer of reinstatement operates to annul a hasty and wrongful discharge of a seaman, and in such case no penalty of one month's wages under Revised Statutes, Sec. 4527, is due the seaman says the Court in *The Meton,* 4 American Maritime Cases, 296, where the plaintiff was discharged after four days of employment, but was offered reinstatement the same day he was discharged, which he refused.

Recovery for Supplies Furnished

"A MARITIME lien, under the act of June 23, 1910, sections 1-3," says the Court in the case of *El Amigo,* 285 Federal Reporter, 868, in which the plaintiff endeavored to recover for supplies furnished to a ship while under a charter party but was held out as being owned by the parties ordering the supplies, for supplies furnished a foreign vessel "is not defeated by showing that such person was charterer, without authority to bind the vessel, where those furnishing the supplies had no knowledge or means of knowledge of such facts." That the charging of the necessaries against the person ordering them does not affect the furnisher's right to a lien where the necessaries are furnished under circumstances giving rise to a lien.

Breach of Charter Party

IN the case of Galban Lobo & Company vs. United States, 285 Federal Reporter, 665, wherein the plaintiff brought suit in Admiralty in personam for damages flowing out of a breach of a charter party. The plaintiff being a Cuban corporation without a residence or principal place of business in this country, the Court held that a suit against the United States cannot be maintained under the Suits in Admiralty Act of March 9th, 1920, section 2, by a non-resident having no place of business in the United States, where the cause of action alleged would not support a suit in rem. The clause in the statute permitting suit to be brought in the district in which the vessel "charged with liability is found" is also unavailing, as there could be no liability in rem where the cargo was never placed on board the vessel, and the charter was cancelled because the vessel was not in readiness to receive it. "Charged with liability" does not mean "attachable by foreign process" but charged with a maritime lien. Nor is the cancellation of a charter party by the charterer, because of failure to have the vessel ready to receive cargo, an abandonment of a claim for damages arising from expenditures for lighterage made necessary by the breach of contract.

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Questions and Answers Relating to Naval Architecture and Marine Engineering

Conducted by James L. Bates, Naval Architect, and W. B. Newton, Marine Engineer

This department is maintained for the purpose of answering all questions relating to ships and their machinery. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

Hot Well Salinity Indicator

Q. (1194).—Please advise if harmful electro action would be likely to occur under the following conditions: A 110-volt light circuit is so arranged that in case sea water should find its way into the hot well the salt water would complete circuit and cause a light to show. If the hot well were absolutely fresh, enough current could not pass between the terminals to cause the light to glow.—D. S. R.

A. (1194).—If the action of the light circuit was sufficiently positive and certain to indicate satisfactorily and promptly small degrees of salinity or acidity, it should be possible to relieve the conditions responsible before serious damage could be done by electrolitic action.

Why Naval Vessels Have a Clipper Stem

Q. (1197).—What is the reason for the different practice in the United States Navy as to type of stem as compared with that in the merchant service?

A. (1197).—The clipper or overhanging stem as fitted on naval vessels provides:

(a) Satisfactory stowage for stockless anchors.
(b) A topside shape which greatly assists in bringing the anchor snugly to its stowage position.
(c) A location of hawse hole such that the anchor drops well clear of the fore foot.
(d) A lead of anchor chain (particularly in the case of the center anchor) such that the danger of nipping across the stem is minimized.
(e) A natural ending, without extreme snubbing, to the vessel's topside waterlines in spite of the rather excessive flare generally used.

In the merchant service the vessels do not spend the time at anchor that the naval vessel does. Speeds are lower and freeboards are greater so that the stowage of an anchor well clear of the ordinary seas is not so difficult. The shape of the sections below the waterline does not require the hawse hole to be so far from the centerline of the ship.

Which Methods Are Preferable for Calculating Displacement, Stability, etc.?

Q. (1195).—Do you consider the method for calculating displacement, stability, etc., used by the Navy Department superior to the methods which are based upon the use of the integrator?

A. (1195).—The method in use by the Navy Department is based upon the use of the trapezoidal rule for integration. This rule simplifies the numerical work but necessitates compensation for the effect of curvature when the ordinates are measured either from the cross sections for immersed area or from the curve of sectional areas for displacement.

When using the integrator the areas are obtained by the instrument and generally "put through" Simpson's rule or some other similar rule with which the compensation necessary with the trapezoidal rule is not required.

The degree of accuracy to be expected is about the same with either method except that all figures used in the Navy Department method are entered on regular forms and are, therefore, readily subject to check. Moreover, in case any question of the accuracy of the work or of the exact steps taken arises, the calculations made by the department's method are invaluable for ready reference. This is not true to the same extent of the integrator methods. In the writer's experience, particularly in large organizations, in which the personnel making routine calculations are subject to considerable change, methods which can easily be reduced to definite forms and which, when carried out properly, result in accurate records of the work done are of especial value.

If the data desired are for one draft only, time will probably be saved by using the integrator. If a complete displacement sheet or cross curves of stability for a considerable range of displacement are required, the department's method would probably be shorter.

Relative Efficiency of Methods for Estimating Weights

Q. (1196).—What can you say of the relative efficiency of the several methods commonly used in making preliminary weight estimates?

A. (1196).—This is too broad a subject to be covered in this department. The following notes may be helpful in outlining it for your further investigation:

Let it first be agreed that the discussion applies only to estimates for hull proper as it is comparatively simple to make weight allowances for machinery, outfit, equipment, etc. The hull, moreover, forms a very large proportion of the weight of the ordinary merchant ship light. Hence the hull weight is the principal object of the preliminary weight estimates.

These are five methods of arriving at a figure for hull weight which are generally used.

(a) Weight per linear foot of midship section multiplied by length times a constant = hull weight. The weight per foot is estimated for the ship in hand and the constant is taken from experience with other ships of the type.

(b) Length times beam times depth times a constant = hull weight. The constant is in this case also taken from other ships of the type.

(c) Recording of the weights of the hull groups such as framing, bulkheads, shell plating, etc., as curves plotted on cubic number ($L \times B \times D$) or the numeral of a classification society. Then building up a hull weight by taking group weights off from these curves.

(d) When the group weights of a similar ship are available taking them as a basis from which to proportion the weights for the new ship in the ratio of dimensions, areas, etc., allowances being for difference in scantlings.

(e) Lay out the principal structural members, as decks, shell, etc., to a small scale and estimate weights on an "allowance for unit area" basis.

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Of course in all the above methods care must be taken to make proper allowance for special features, perhaps not covered in the type used.

The writer has used all of the above methods except (c) and found them all reasonably satisfactory, if carefully and understandingly used. It would seem that (c) would be very satisfactory when dealing with well established types for which a considerable quantity of information was available.

The writer has found (d) to be the best where a really satisfactory type ship and its data are available. When investigating a new field (e) is the best.

Methods (a) and (b) do not give as accurate results as (d) and (e) unless the data upon which they are based are exceptionally good. Methods (a) and (b) give no assistance in fixing the location of the center of gravity of the hull. Methods (c), (d) and (e) are satisfactory in this respect.

NEW BOOKS

SHIP SUBSIDIES. (Reference Shelf Series.) Compiled by Lamar T. Berman. Size, 5 by 7¾ inches. Pages, 112. New York, 1923: The H. T. Wilson Company.

This volume is written along the general lines of the Reference Shelf Series. The history and present status of the subsidy question and articles covering arguments for and against are included.

A feature of the book is an outline of affirmative and negative briefs suitable for a debate which should be of particular interest to schools and debating societies. The bibliography giving a long list of references to books and periodicals in which the subsidy question is discussed is also of value.

Industrial Oil Engineering

Reviewed by James A. Kelley*

HANDBOOK OF INDUSTRIAL OIL ENGINEERING. By John Rome Battle. Size, 5½ by 7¾ inches. Pages, 1,131. Illustrations, 471. Philadelphia, 1923: J. B. Lippincott Company.

This volume is essentially a handbook on the diversified uses of oil and its scope includes, as set forth on the title page, "A Reference Book of Data, relating to lubrication and industrial oils, including tables, general oil information, engineering and industrial requirements for the use of oil engineers, oil salesmen, oil equipment manufacturers, mechanical engineers, machinery designers, mill and power plant superintendents, and others interested in the efficient utilization of oil products and equipment and the conservation of power. It includes the Lubricating Engineer's Handbook revised."

At the outset it should be stated that this work does not include data or text concerning oil burning equipment and the burning of oil. The author announces his intention of publishing a manuscript especially covering this important branch of oil engineering.

The volume is replete with data, tables, diagrams and illustrations, and covers each subject in a remarkably clear and thorough manner. For example, the author is not content with describing the lubrication of bearings but gives a great deal of valuable information about every type of bearing encountered in practice. Again, in treating the subject of lubricating forming machinery, cutting metal, etc., a great deal of instructive data is included concerning the theory of cutting operations.

A recounting of the treatment of each phase of the industry involved in core making, textile mills, etc., etc., would be too lengthy for this review, but it is to be remarked that in each case, the subject is thoroughly treated, and every chapter speaks loudly of the author's exhaustive and painstaking research and study. It is only to be regretted that the inclusion of the oil burning field would have made this splendid volume too lengthy.

*Naval architect, Morse Dry Dock and Repair Company, Brooklyn, N. Y.

LETTERS TO THE EDITOR

Automatic Steering

It was with a great deal of interest that I read in your March issue the article by Mr. R. H. Rogers, describing the "Wake System of Automatic Steering." It certainly appears to be a simple method and to possess a considerable degree of merit, in a great measure overcoming the difficulty of personal judgment as to the leeway the ship is making.

It does that, however, only in a measure. It takes care of leeway produced by the action of the wind, or through the behavior of the ship as to its steering, but it introduces a new error, which in many cases may lead to shipwreck, if too much reliance is placed on the automatic correctness of the steering.

This is due to the fact that when crossing a water current, whether tidal or of other kind, the drag used will drift with the current and thus make the wire connecting it to the vessel form an angle with the true course made good by the vessel. This angle will depend upon the speed of the water current and the angle at which the ship crosses the same.

A little calculation will show that with currents such as are frequently found along coasts, and with ordinary speeds of ships, this introduces a very serious error, which, especially in a fog, might easily lead to disaster. If this "wake system" is used, it is therefore just as important for the navigator to exercise his personal judgment as with any other kind of steering, automatic or otherwise, and it is therefore dangerous to spread the idea that any new system such as now introduced will overcome vigil on the part of the officers of the ship.

It is true that Mr. Rogers states that cumulative errors may occur, but that is something quite different from mentioning this, in reality, very serious error that is caused through the very principle under which the apparatus operates. At any rate it would seem important enough to have attention called to it.

Los Angeles, Cal. E. T. SEDERHOLM.

Fletcher Company Wins St. Louis Case

Suit Attracted Considerable Attention, There Being More Money Involved Than in Any Other Pending Admiralty Case

THE case of International Mercantile Marine Company against W. & A. Fletcher Company, arising out of the burning of the former American liner *St. Louis*, at the shipyard of W. & A. Fletcher Company, in Hoboken, on January 8, 1920, has been decided in favor of the W. & A. Fletcher Company by United States Circuit Judge Ward, sitting in admiralty in the United States District Court for the Southern District of New York.

The case has attracted a great deal of attention in shipping and shipbuilding circles because of the large amount of money involved, probably the largest in any admiralty case pending in the courts. While the suit was brought in the name of the International Mercantile Marine Company, the real parties in interest were underwriters, particularly British underwriters, who, the court said, properly should have been made

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parties to the suit. The International Mercantile Marine Company was not itself interested in the litigation in any way.

Sought to Recover $2,000,000

The underwriters had paid a total loss on the *St. Louis* of approximately $1,600,000, and they sought to recover $2,000,000 from the Fletcher Company, not only for the total loss of the *St. Louis,* but also for damages to the *Kroonland,* undergoing repairs at the Fletcher yard, which resulted from the *St. Louis* listing over on her while the fire was being extinguished.

The suit was brought upon the charge that the fire had been started by the negligent use of a blow torch and a volatile varnish remover, in removing varnish from the grand staircase of the vessel. The court held that the fire was not started by the use of a blow torch; that a torch was not used where libelant's witnesses had claimed, but it found that the fire was started in a piece of waste.

Contract Made Insurance Companies Responsible

The court also found that it was a condition of the agreement under which the work was undertaken that the Fletcher Company should not be liable for losses ordinarily coverable by marine insurance, of which fire was one. Subsequent to the time the agreement was made, the International Mercantile Marine Company, as agent of the United States Shipping Board, negotiated with the Fletcher Company and Cramp Shipbuilding Company for the repair of the *Leviathan,* and in the offer which was submitted by the Fletcher and Cramp companies there was inserted a provision that the United States would assume all usual risks on the steamer and materials delivered to the contractor, ordinarily coverable by insurance, and the court held that the offer to repair the *Leviathan* evidenced the contract covering the repair of the *St. Louis,* as the Fletcher and Cramp companies had offered to make the repairs on the *Leviathan* on the same terms and conditions as the Fletcher Company was making them on the International Mercantile Marine Company's own ships.

Messrs. Ira A. Campbell and John M. Woolsey, of the firm of Kirlin, Woolsey, Campbell, Hickox & Keating, and Clarence Bishop Smith, of the firm of Haight, Smith, Griffin & Deming, appeared for W. & A. Fletcher Company, and Messrs. Charles C. Burlingham and Chauncey I. Clark, of the firm of Burlingham, Veeder, Masten & Fearey, and Earle Farwell, of the firm of Barry, Wainwright, Thatcher & Symmers, appeared for the underwriters.

PERSONAL MENTION

Ben Barber, for three years district counsel for the northeastern district of the United States Shipping Board, has resigned to enter private practice in New York.

N. M. Leach was elected president of the Steele Steamship Line at the recent annual meeting of the directors, held at New Orleans. Semmes Steele was elected vice-president.

J. V. Blake, assistant to W. A. Morrisey, tank steamship executive for the United States Shipping Board, has resigned to become manager of tank steamships for the Pure Oil Company.

Thomas G. Plant, formerly manager for McCormick, McPherson and Lapham, has been appointed operating manager of the American-Hawaiian Line, San Francisco, Cal. Mr. Plant was at one time the United States Shipping Board's assistant director at San Francisco.

C. C. Jacobson, vice-president of the National Association of Marine Designers and formerly in the marine division of the Department of Plant & Structures of the City of New York, is now connected with the engineering department of the Atlantic, Gulf & Pacific Company, engineers and contractors, 2407 Park Row Building, New York City.

R. T. Gordon, for the past eight years connected with the New York sales office of the Alberger Pump and Condenser Company, has resigned to accept a position in the sales department of Dean Brothers Company, of Indianapolis, Ind., manufacturers of pumping machinery, and will be located in their New York office at 141 Broadway.

Captain Thomas Kier has been appointed to the command of the new Hamburg-American Line steamship *Albert Ballin,* according to information received from Hamburg by the United American Lines who are the United States agents for the Hamburg-American Line. Captain Kier, who is commodore of the Hamburg-American fleet, has been in service with the company for thirty years. Prior to the war he was commander of the *Imperator.*

Captain John Bradshaw, commander of the new 27,000-ton Red Star Liner *Belgenland,* which recently arrived at New York on her maiden voyage from Antwerp, is an American citizen and a resident of New York City. His first command was that of the *Rhynland,* of the Red Star Line, to which he was appointed in 1899. Since that date he has held command of the *Samland, Finland, Kroonland* and *Lapland,* the last-named from her debut in 1912 until his appointment to the new *Belgenland* in January of the present year. In command of the *Lapland* during the World War, Captain Bradshaw made seventy-four of the seventy-six voyages of that vessel as a troop transport. Captain Bradshaw had the distinction of commanding one of the first steamers to take troops from Canada to England for the conflict, as the *Lapland* was in the first convoy that put out from Montreal. She was also the first ship to bring Canadian troops home after the signing of the armistice.

Captain John Bradshaw

E. P. Erckenbrack, who has been filling the position of district director of the United States Shipping Board for Brazil at Rio since February 1, 1920, has been appointed district director of the Board at Seattle, succeeding Robert M. Semmes, resigned. Mr. Erckenbrack is very well known on the Pacific Coast and undoubtedly his appointment to that office will result in increased business for Board line vessels trading to and from the Puget Sound district.

F. W. Leahy, president of the Leahy Engineering Company, Cincinnati, O., has been appointed supervising engineer of The Campbell's Creek Coal Company. In this capacity he will have charge of both the new construction and the maintenance of all floating equipment of this company. He will also continue as president of the Leahy Engineering Company. Mr. Leahy has had many years' experience as chief engineer of ocean-going ships and is well known on both the Atlantic and Pacific coasts. Before establishing the Leahy Engineering Company he was for several years New York manager of the Diamond Power Specialty Company.

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HUGH GALLAGHER, veteran of the Admiral line, has been promoted from superintendent of the company to assistant operating manager.

CAPTAIN R. C. BRENNAN, for a number of years port captain of the Admiral line, has been appointed operating manager of the company and will have charge of all physical operations of the company's extensive coastwise services.

G. H. FROEBEL, the new manager of the marine sales department of the Westinghouse Electric & Manufacturing Company, whose appointment, effective April 1, was announced in our April issue, will have his headquarters at the East Pittsburgh works of the Westinghouse Company. In his new position, he will be a member of the Domestic Sales Committee, composed of the heads of the various sales departments. Mr. Froebel was born at Boerne, Tex., on October 1, 1889, and was graduated from the San Antonio High School in 1907 and attended the University of Texas from 1907 to 1909. The new marine head entered the employ of the Westinghouse Company in November, 1912, taking up the company's graduate apprentice shop course. He was transferred in 1914 to the Dallas, Texas, office of the company as industrial salesman. Two years later he opened the Houston, Tex., branch office as manager of the Industrial Division for the entire district. He remained there until 1918, when he entered the United States Army, as a lieutenant in the Construction Division. After being discharged from the Army in April, 1919, he re-entered the employ of the Westinghouse Company and was placed in charge of the Houston branch office, of which he became manager in November, 1919. Mr. Froebel is a member of the American Society of Military Engineers and an associate member of the American Institute of Electrical Engineers.

G. H. Froebel

WILLIAM M. KENNEDY, until recently associated with the United States Shipping Board at 45 Broadway, New York, as supervising local manager, has assumed in full the duties of assistant to Andrew Fletcher, Jr., in the direction of work at the shipyard of W. & A. Fletcher, Hoboken, N. J. Mr. Kennedy resigned from the Shipping Board to undertake the supervision of work at the Fletcher plant several weeks ago and he brings to his new connection a wealth of experience gained in more than twenty-two years' association with ships and ship construction. Starting as an apprentice with the Maryland Steel Company, Sparrow's Point, Md., he subsequently became a mechanic, supervisor of new construction, draftsman, estimator and executive in charge of estimating and planning. During this time he was employed on work at several private shipyards, including the Maryland Steel Company and the Fore River Shipbuilding Company at Quincy, Mass., as well as naval construction at the Charleston, S. C., and New York Navy Yards. In 1915 Mr. Kennedy became associated with work at the Panama Canal in an executive capacity and played a prominent part in the installation of the planning and production system used in the canal dry docks and shops. He subsequently left the Panama Canal to become assistant production manager of the Merchant Shipbuilding Corporation at Harriman, Pa., later becoming assistant works manager and then assistant to the general manager. On April 1, 1920, he was transferred to the Chester yard of the Merchant Shipbuilding Corporation as works superintendent and about a year later resigned and became associated with the Shipping Board.

OBITUARY

GEORGE PALMER FENNER, assistant treasurer of the American-Hawaiian Steamship Company, died at his home in Flushing, L. I., recently. He was born in Brighton, England, and had engaged in the steamship business the greater part of his life.

WILLIAM W. STODDARD, the oldest employee of the New York Navy Yard, died at his home in Brooklyn, N. Y., on April 3 at the age of 87. Mr. Stoddard was a veteran of the civil war. In the Spanish war he helped to outfit naval vessels for service, and again in the world war he performed similar duty, having charge of 6,000 men at the New York Navy Yard.

ADDISON CHILDS DAMON, associated with the yacht building concern of George Lawley & Son Corporation in Neponset, Mass., died recently at his home, in Dorchester, Mass. Mr. Damon was sixty-two years old. Almost immediately upon leaving school he associated himself with the Lawley corporation, where he became an expert draughtsman and at the time of his death had been in its employ forty years.

CAPTAIN GEORGE L. NORTON, from 1885 to 1919 editor and publisher of *The Marine Journal,* died at his home in New York on March 24, at the age of 87. Captain Norton was born in Castine, Me., in 1837 and at the age of 14 went to sea. Starting at the bottom, this sturdy scion of a New England sea-faring family rapidly rose to a position of command and influence in the coastwise steamship service. At the outbreak of the civil war he was second officer of the steamship *Saxon,* which became an army transport. Later he become first officer and master of the *Saxon* and in 1866 took command of the *Ashland,* pioneer steamship of the Metropolitan Steamship Line running on the outside route between New York and Boston. In 1871 Captain Norton assumed command of the *Crescent City,* operating in the New York-New Orleans passenger and cargo service and in the same year he was appointed harbor master at the Port of New Orleans. Five years later Captain Norton received the appointment as supervising inspector of steam vessels for the Gulf States, a post which he held for eight years. In 1885 he came to New York and started his long and eminently successful journalistic career as editor and publisher of *The Marine Journal.* In that year he became a member of the National Board of Steam Navigation and of the Marine Society of the City of New York. His long life brought to Captain Norton many honors and a host of friends among men prominent in shipping and government circles. He was a member of the Board of Pilot Commissioners and for several years a trustee of Sailors' Snug Harbor.

Capt. George L. Norton

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The Month's Shipping and Shipbuilding News in Brief

Shipyard, Steamship and Port Activities and Other Notes of Interest in All Branches of the Marine Industries

First Quarter Produces Ninety Million Dollar Business

OVER ninety million dollars' worth of marine work, all classes, has been reported in MARINE ENGINEERING AND SHIPPING AGE from January 1 to April 1 of this year, according to statistics compiled from our records. These figures include ship and port work, both contemplated and awarded.

Bearing in mind the general business situation at home and abroad, it is conceded that the first quarter of the year in maritime affairs presents a highly credible showing. The figures given represent only that work which the magazine reported and only those contract awards have been considered for which definite prices were available.

Vessel construction and reconditioning recorded in these columns during the first three months of the year as under contemplation totaled $12,005,000, while contracts were awarded for similar work in the amount of $8,100,267. A strong trend in the direction of port improvement is seen in the total of $61,614,696 reported in the "contemplated" stage in this branch of marine work, with $8,486,071 in contracts placed. The total for ship work, contemplated and awarded, is $20,105,276, and that for port developments $70,100,767, bringing the grand total for all classes up to $90,206,034.

Optimism is the key word for the marine field at the present time and the only basis upon which constructive progress can continue. It is realized that America's maritime industry must carry on in spite of the non-passage of the Subsidy Bill, and indications are that the second quarter of the year will be even more productive of substantial business than the first quarter. Ship construction and reconditioning contracts which will necessitate the expenditure of many millions of dollars are now pending, a goodly portion of which will have arrived at the "awarded" stage in the near future.

With these facts to consider, there seems to be every reason why every business man having an active interest in the marine industry should put forth renewed effort to see that his company gets its share of the contracts being placed every week.

Specifications Out for Ferryboat for New York Central

PLANS and specifications for the construction of a steel ferryboat for the New York Central Railroad Company have been issued, bids to be opened on May 15. J. W. Millard & Brother, 17 State Street, are the naval architects in charge.

The proposed vessel will have a length over guards of 210 feet, length between perpendiculars 180 feet, extreme beam over guards 66 feet 2½ inches, beam at deck 45 feet, beam on water line 38 feet, depth amidships 17 feet 6 inches.

Propulsion will be by two direct acting, 2-cylinder, compound, jet condensing steam engines, 19 inches by 38 inches by 28-inch stroke. Steam will be supplied by two Scotch return tube boilers, providing pressure at 150 pounds.

Board to Sell 100 Ships

It has been learned that the Shipping Board is preparing to offer 100 vessels for sale as scrap within the next few days, including eighty old German-built ships and twenty built during the war, which for various reasons are considered unsuitable for operation. They are at the present time tied up at ports along the Atlantic, Gulf and Pacific coasts and some in the Philippines. While the majority of the vessels will probably be junked for steel, some may be sold with permission for transfer of registry if the purchasers are willing to spend the necessary amounts to put them into condition for operation. The vessels average about 7,000 deadweight tons.

Federal Shipbuilding Company Submits Low Bid of $1,496,000 for Eight Ferryboats for New York

THE Federal Shipbuilding Company, of Kearny, N. J., submitted the low tender for the construction of eight ferryboats for the City of New York at the opening of bids by the Department of Plant and Structures, at 2 P. M., on April 26. The prices submitted provided for the vessels propelled by steam engines and by heavy duty oil engines, the boats to be double-ended, for carrying passengers and vehicles, each having a length over guards of 140 feet, beam over guards 52 feet, beam of hull molded 36 feet and draft of 8 feet 6 inches. The figures submitted were as follows:

	1	2	3	4	5	6	7	8
Federal								
Steam Engines	$211,000	$199,000	$195,000	$190,000	$190,000	$187,000	$187,000	$187,000
McIntosh & Seymour	272,000	262,000	257,000	253,000	253,000	250,000	250,000	250,000
Worthington	238,000	227,000	224,000	220,000	226,000	216,000	216,000	216,000
Staten Island Shipbuilding Co.								
Steam Engines	249,900	244,000	242,000	241,000	240,000	239,500	239,200	239,000
Ingersoll-Rand	274,900	268,900	266,900	255,500	264,900	264,500	264,100	264,000
Worthington	272,000	262,000	260,000	259,000	258,000	257,500	257,200	257,000
McIntosh & Seymour	295,000	289,000	287,000	286,000	285,000	284,500	284,200	284,000
Tebo								
Steam Engines	256,000	242,000	241,000	241,000	241,000	241,000	241,000	241,000
McIntosh & Seymour	298,500	291,200	290,000	290,000	290,000	290,000	290,000	290,000
Sullivan								
Steam Engines	210,000	420,000	.....	.....	.....	.....	.....	.....

Name of Sun Shipyard Changed

The Sun Shipbuilding Company has announced a change of name to the Sun Shipbuilding & Dry Dock Company. In addition to its building facilities, the yard at Chester, Pa., operates a large floating dry dock.

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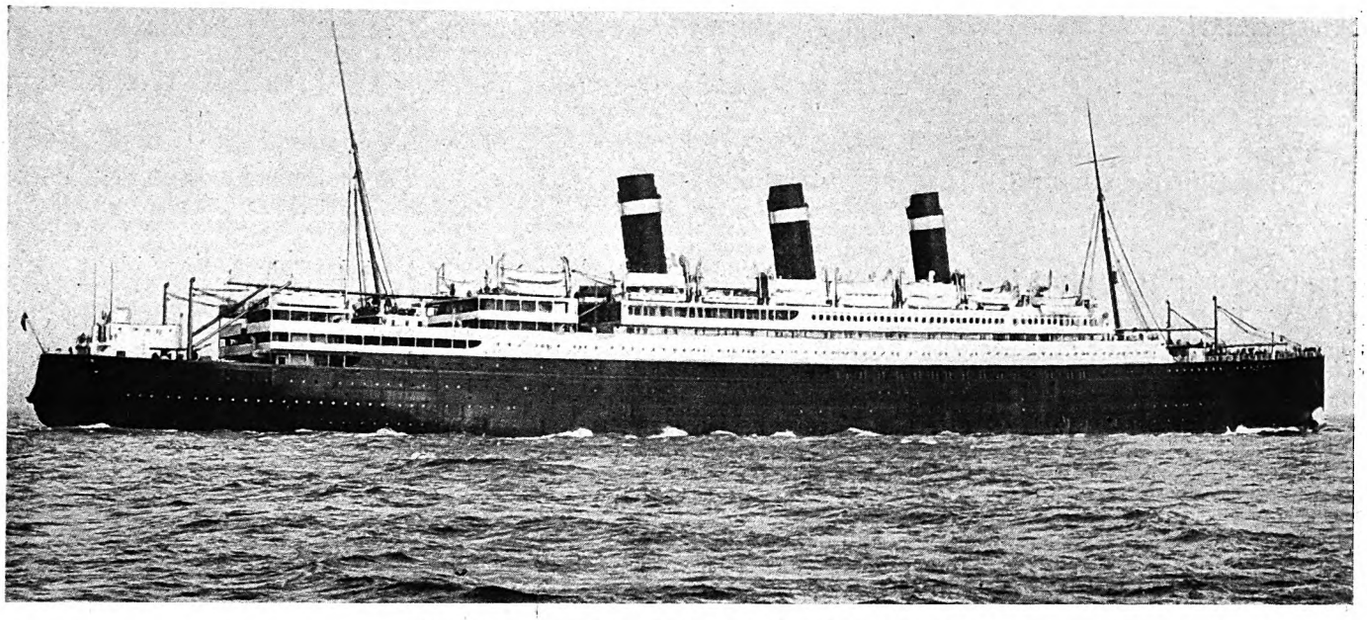


The New 27,000-Ton Red Star Liner Belgenland

New Red Star Liner Belgenland Arrives on Her Maiden Voyage

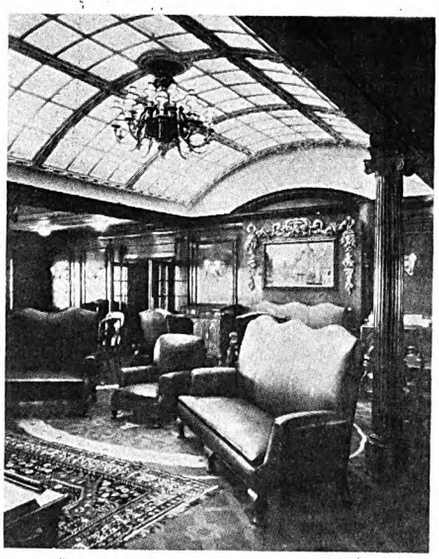
THE new 27,000-ton passenger liner *Belgenland* of the Red Star Line which recently arrived in New York on her maiden voyage from Antwerp contains exceptionally elaborate accommodations as well as every convenience and comfort usually found in first class hotels.

The *Belgenland* is a triple screw steamer having a length of 697 feet and a beam of 78 feet 6 inches. She has a passenger capacity of 2,700, of whom 400 can be accomodated in the first cabin. Her propelling machinery is a combination of reciprocating engines on the wing shafts with a turbine on the center shaft similar to the arrangement which has been found very successful on the *Olympic*. Following the latest passenger ship practice which permits of clear and rapid bunkering she has been fitted to use oil as fuel under her boilers.

PUBLIC ROOMS

The public rooms are arranged practically en suite on the "A" deck. The drawing room is the farthest forward and is decorated in lustreless white. Next is the lounge in which the prevailing color is ultra-marine. Bay windows on each side give an unobstructed view of the promenade deck. Following the lounge is a large smoking room containing a fireplace, card tables and leather upholstered furniture. Back of the smoking room is a veranda sheltered by green latticed walls.

The *Belgenland* differs from other first class passenger liners in the number of suites, intercommunicating rooms and private baths. On "B" deck there are 32 rooms with private baths and 8 with private sitting rooms as well. The intercommunicating system allows various combinations of suites to be made. In the bedrooms are numerous novelties in the way of fittings, such as davenports that become beds, buffets that may be converted into washstands, Pullman upper berths for children, heated towel racks, showers, steam heat regulation by thermostats, electric fans, etc.



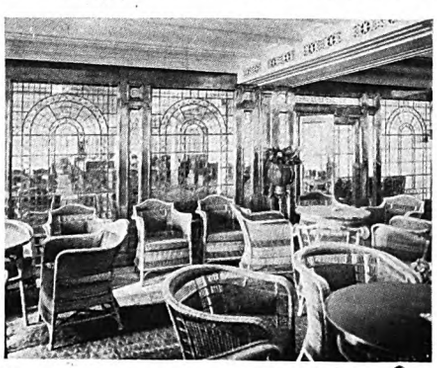
Smoking Room

Philadelphia Lacks Dry Docking Facilities

ALTHOUGH a total of 3,089,000 tons of ships engaged in foreign trade entered the Port of Philadelphia during 1922 in addition to a considerable tonnage engaged in the intercoastal trade, declared Mr. J. Stuart Crandall in addressing the April meeting of the Delaware branch of the American Society of Marine Designers, Philadelphia has only two commercial dry docks capable of handling ships over 350 feet in length.

From this it will be seen, said Mr. Crandall, that Philadelphia has fewer large dry docks per ton of shipping than any other port. This is also true, he said, in regard to the number of smaller dry docks. This is not a balanced condition and it is practically certain that the addition of at least one and perhaps two dry docks for ships over 350 feet long would more than justify the capital outlay.

Veranda Cafe



Ballroom and Dining Saloon

Sitting Room of Private Suite

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Steamship Men Opposed to Government Operation

Personal Opinions of Prominent Shipowners Given at Propeller Club Luncheons

THREE prominent shipping executives, namely, Mr. Charles H. Potter, president of the Maritime Exchange and also of the United States Ship Operators' Association, Mr. Alfred Gilbert Smith, president of the American Steamship Owners' Association, and Mr. R. H. M. Robinson, president of the United American Lines, addressed the April meetings of the Propeller Club in New York on the shipping situation. It is to be noted that they all made it plain at the start that they were giving their own personal views and that they were not to be interpreted as representing any organization.

Mr. Potter after calling attention to the great coastwise fleet of some 125 splendid vessels which has been developed under the protection of our coastwise laws declared that unless something is done for our overseas merchant marine in the near future we would become the laughing stock of the world.

Scrap Inefficient Tonnage

It would be for the best interests of the Government, shipbuilders, shipowners and ship operators to scrap all undesirable vessels, declared Mr. Potter. We should not, however, sacrifice the whole merchant marine. It may take two or three years with all pulling together to solve the problem. If however the responsibilities of the operators are gradually increased and some arrangement is made whereby special profits can be put into a fund which at the end of three years could apply in part on the purchase price of new ships that would be a solution which would prevent the vessels from falling into the hands of a few.

Mr. R. H. M. Robinson pointed out that after a year of effort to obtain constructive shipping legislation not only was the subsidy bill defeated but the shipowner had been saddled with additional burdens through the ruling prohibiting the sale of liquor on American ships and through the practical limitation of repairs to American shipyards. He also called attention to the recent reduction in seamen's wages in England while the tendency here was distinctly upward.

Mr. Robinson said that the primary purposes of an American merchant marine were to serve as a naval auxiliary, to avoid isolation when ships of other nations are withdrawn in time of war and to insure that American goods can be delivered directly and regularly without transshipment.

Opposed to Government Operation

Government operation of a large fleet, said Mr. Robinson, is not in accordance with the principles of American institutions. He thought the effect of such a policy would be to drive more vessels into the intercoastal trade, to cause a transfer of flag, if that is possible and to send the remainder to the scrap heap.

Making Shipping a Non-Partisan Issue

Mr. Alfred Gilbert Smith recommended that a non-partisan body be formed to furnish facts and findings upon which a permanent solution of the merchant marine problem can be developed. He pointed out that a solution can be expedited by all maritime interests working together. As President Cleveland once said, it is a condition and not a theory that confronts us.

Our first step, said Mr. Smith, is to see that the policy adopted is one that the Government will adhere to. Our people have been very busy building a vast empire and it cannot be expected that a merchant marine can be created over night. Business organizations and foreign trade are just as necessary as ships, to establish a successful merchant marine, he declared.

The present depression in shipping, Mr. Smith pointed out, is due entirely to lack of foreign trade. When overseas business is bad, shipping is bound to suffer. Competition in service leads to the building up of trade but conferences maintain stability. Although rates must be such that our exporters can compete, it is more important that one exporter receives the same rates as his competitor.

Shipping Board Offers Fleet for Sale Overlapping Services to Be Eliminated Berths Regrouped Into Eighteen Lines

THE United States Shipping Board has announced that it has issued a call for bids for the purchase of passenger and cargo ships from the board's fleet. All bids must reach the board by May 28, 1923. Bidders are asked to enter into an agreement to maintain line service on one or more of 18 routes named by the board, or such other routes, acceptable to the board, as may be proposed by the bidder.

It was announced that the Board has decided to re-group the regular services now being operated by it, through agents, so that each service shall include a reasonably wide range at each terminus, the purpose being to eliminate overlapping or duplication, while at the same time affording larger markets from which and to which to take cargo. As re-grouped, the proposed eighteen services will be as follows:

No.	From	To
1.	North Atlantic	United Kingdom (Great Britain and Ireland)
2.	Gulf and South Atlantic	United Kingdom (Great Britain and Ireland)
3.	North Atlantic	Continental Europe, North of Bordeaux
4.	Gulf and South Atlantic	Continental Europe North of Bordeaux
5.	North Atlantic	Continental Europe, South of Bordeaux including all Mediterranean and Black Sea
6.	Gulf and South Atlantic	Continental Europe, South of Bordeaux including all Mediterranean and Black Sea
7.	Atlantic Coast and Gulf	East Coast South America
8.	Atlantic Coast and Gulf	Orient and Philippines
9.	Atlantic Coast and Gulf	India and Dutch East Indies
10.	Atlantic Coast and Gulf	Australia
11.	Atlantic Coast and Gulf	South and East Africa
12.	Atlantic Coast and Gulf	West Africa
13.	Pacific Coast	East Coast South America
14.	Pacific Coast	West Coast South America
15.	North Pacific	Orient and Philippines
16.	South Pacific	Orient and Philippines
17.	Pacific Coast	Europe
18.	Pacific Coast	Australia

The board announces that the bidder may make such offers as he desires; but every bidder shall include in his offer a guarantee to operate the ships to be purchased for a specified period over the routes selected by him, and not elsewhere. The bidder must specify the names of the ships he desires to purchase; the price offered and terms of payment; the route over which he will undertake to maintain service; the charter, frequency, and extent of such service; period of time for which he will guarantee maintenance of service; and the nature and terms of the guarantee.

So far as possible the bidder shall select vessels now being operated on routes included in the route for which he makes his bid. Bidders are, however, free to specify vessels from the board's laid-up fleet, or even those in operation on other routes.

The bidder may make his bid upon the understanding that the board, upon acceptance of any tender and the making of a contract with adequate guarantee for maintenance of service, will agree not to operate in competition directly or indirectly, government-owned ships, while adequate service is maintained; that it will neither charter nor sell, for operation on that route, at a price lower than current commercial charter rates or world market prices for unrestricted operation.

Prospective bidders are invited to come to Washington to confer with the Commissioners of the United States Shipping Board who, together with the officials of the United States Shipping Board Emergency Fleet Corporation, will be ready at all times to aid responsible bidders to formulate bona fide bids.

Information is available of the operating costs of the various classes of board vessels, and the financial results of existing services.

The board reserves the right to reject any and all bids.

Correction

In the description of the electric ferryboat *Poughkeepsie* published in our March issue the name of the manufacturer of the reduction gears and flexible couplings installed in the vessel was inadvertently omitted. The gears and couplings were the Falk reduction gears and Falk-Bibby flexible couplings manufactured by the Falk Company, Milwaukee, Wis.

Cory Extends Service to Boston District

Chas. Cory & Son, Inc., of New York, manufacturer of ships' telegraphs, marine signaling, communicating and lighting equipment has opened an office in Boston at 88 Broad street, in charge of A. E. Sargent, well-known electrical engineer, who for many years was connected with the Bethlehem Shipbuilding Corporation at the Fore River plant.

Combustion Engineering Corporation to Handle Uehling Interests in Canada

The Combustion Engineering Corporation, Ltd., and the Uehling Instrument Company have recently entered into an agreement whereby Uehling interests in the Dominion of Canada and Newfoundland will be handled exclusively by the Combustion Engineering Corporation, Ltd., with principal offices located in Toronto, Montreal, Winnipeg and Vancouver.

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Foreign Shipping and Shipbuilding Activities

German Shipbuilding in 1922 Analyzed

VESSELS under construction in German yards in 1922 for both German and foreign account totalled 1,353, of 1,495,700 gross tons, a decrease of 14.9 percent from the 1921 figure, according to the Statistische Reichsamt, forwarded to the Department of Commerce by Consul O. N. Nielsen, Berlin; but tonnage completed during the year was 64.5 percent greater in 1922 than in 1921. The number of ships completed in 1922 was 648.

Of the total under construction for German accounts in 1921, 1,086 vessels, of 1,667,000 tons, were seagoing merchant ships; in 1922 this class of vessel being built for German companies dropped to 407, with a total tonnage of 1,171,600, a decrease in tonnage of 29.6 percent.

The German tendency toward construction of motorships is shown by the fact that in 1920 motorships aggregating 73,000 tons were under construction; in 1921, 135,000 tons; and in 1922, 121,000 tons.

In both 1921 and 1922 there were under construction in foreign yards for German accounts between 40,000 and 50,000 gross registered tons. These consisted of orders placed in the hands of former German companies in Danzig and Memel before the separation of those districts from Germany, and now represent tonnage intended for the reparations account.

In 1920 about 67 percent of the vessels completed came from the North Sea yards; in 1921, 60 percent; and in 1922, 56 percent. The Baltic Sea yards, on the other hand, show increasing business in 1921 and 1922, in the latter year delivering 34 percent, as compared with 33 percent in 1921 and 29 percent in 1920. Inland shipyards built approximately 12,000 tons in 1920, 72,000 tons in 1921, and 31,000 tons in 1922.

Norwegian Course and Speed Recorder Invented

According to the Department of Commerce, a patent has recently been granted in Norway for an apparatus that by the aid of an electric clock connecting the compass, log and clock will automatically register the speed, course and time.

This invention, which is very small and compact, can be installed anywhere on board ship enabling the officers to give incontrovertible proof of the dispositions of the ship.

Italy to Build Big Liners

ROME, Italy (Special).—As a result of the protective policy adopted by the new Mussolini Government, the Italian shipbuilding firm of Tosi Shipyards Company has received a contract for two ocean liners of about 20,000 tons each. These two ships are for the account of the Lloyd Sabaudo of Genoa, which has had many of its former ships, notably the *Conte Rosso* and *Conte Verde,* built in Great Britain. Italy's protective policy for shipbuilding is expected to do a great deal for that industry; in fact, satisfactory results have already been noted.

Oil Burning Installations and Electric Drive Receiving Attention of French Shipowners

By Our Paris Correspondent

FRANCE has noted the general movement in the various maritime countries in favor of the adoption of oil-burning under boilers. French shipowners now realize the advantages and economy to be obtained with oil-burning vessels in such matters as a reduced crew, greater bunkering facilities, quicker turn around, less wear on the boilers and other advantages such as general cleanliness of passenger accommodations.

The commercial success of the *Paris,* the largest French vessel afloat, which was placed in service by the Compagnie Generale Transatlantique in June, 1921, has fully confirmed the general opinion in this respect and this company is therefore considering, with more and more favorable attention the conversion of their second largest liner, the *France,* to oil-burning.

Conversion of the France

It is already ascertained that such a transformation would result in a reduction in personnel of no less than 160 men. In addition to the saving in wages there must be added the saving in fuel consumption and also the profit of making one more return voyage per annum. Taking into account these various advantages it is estimated that the conversion of the France to an oil-burner, which would involve an expenditure of about 6 million francs, would result in a total saving of about 1 million francs per year.

As the *France* is only 11 years old the French Line have very good reason for this conversion and there is little doubt but that a decision will be made to go ahead with this work in the near future.

In case the conversion to oil-burning should be decided upon by the owners, it would doubtless be carried out by the end of 1923 when a general overhaul of the boilers is due in order to comply with the requirements of the Bureau Veritas. It is estimated that the liner would only have to be laid up for about 5 months.

Contract Will Probably Go to English Firm

As regards the system of oil burning which would be adopted on the *France,* it is a question whether any of the few French firms who specialize in this equipment would be in a position to offer sufficient guarantees of reliability to secure such a big order and it is hinted that this work might be placed with the Wallsend Slipway Engineering Company, who supplied the oil burning installation of the *Paris.* It may be pointed out that this British firm has supplied most of the oil-burning equipment on French vessels.

Up to the present time there are but two firms in France which are in a position to install oil burning installations of their own system under satisfactory conditions: these are the Chantiers de la Gironde, who are now completing the steamship *Aramis* built to the account of the Messageries Maritimes, and the Forges et Chantiers de la Mediterranee, which have just supplied the oil burning equipment for four passenger steamers of the *Mustapha II* type built for the account of the Department of Mercantile Marine (the *Gouverneur-General-Tirman, Gouverneur-General-Cambon, Gouverneur-General-Lepine and Gouverneur-General-Laferriere*). The Forges et Chantiers de la Mediterranee have also carried out the oil burning installation on the two sister ships *Guaruja* and *Ipanema,* built for the account of the Societe Generale des Transports Maritimes à Vapeur, Marseilles.

Electric Drive

These two steamers are the first and so far *the only French vessels* equipped with turbo-electrical propulsion. These ships have a displacement of 8,000 tons and a deadweight carrying-capacity of 5,130 tons at 23 feet draft. (Length, 360 feet 2 inches; breadth, 46 feet 2 inches; depth, 26 feet 3 inches.) The propelling machinery consists of two turbo-alternators supplied by the Etablissements Sautter-Harlé of 1,000 kilowatts running at 3,000 revolutions per minute. The reduction is 24, the propeller revolutions per minute being 123. Two speeds are provided for, namely, for cargo business, 10 knots, and for passenger business, 13 knots.

French Line Considering Electric Drive

In connection with the future adoption of electric drive by French shipowners it is learned on good authority that the French Line is considering this mode of propulsion for their new passenger steamer *De Grasse,* which is under construction at Birkenhead at the yards of Messrs. Cammell Laird and Company.

First Large French Cargo-Motorship Nearing Completion

The first big French vessel to be fitted with Diesel propulsion is the cargo-motorship *Camranh* which is being completed by the Chantiers de la Loire at Nantes for the account of the Chargeurs Reunis. This vessel is of 11,700 tons deadweight. Her propelling machinery consists of two Sulzer four-cylinder two-cycle marine engines, each developing 1,700 shaft horsepower, which were built at the Winterthur works of Messrs. Sulzer Brothers. In addition to the main engines, two 410 brake horsepower four-cylinder Sulzer two-cycle engines are provided to drive dynamos at 200 revolutions per minute.

France to Build Six Submarines

PARIS, France (Special).—Six new submarines of 1,000 tons displacement each have been ordered by the French Admiralty. They will be equipped with twin engines of 2,000 horsepower which have been ordered from the Societe Generale Electrique of Nancy. It is reported that six additional submarines have been authorized but, so far as can be ascertained, the contracts have not yet been placed.

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Marine Construction News of the Month

Ship Contracts — New Ship Concerns and Shipyard Improvements—Terminal Projects—Government Contracts

SHIPBUILDING AND REPAIRS

Rudder Replaced, Portland, Ore.—The steamer Flavel was drydocked at Portland to have her rudder replaced.

Shipyard Busy, Oakland, Cal.—The Moore Shipyard is fitting out the salmon packers' fleet for the summer season.

Steamer Drydocked, Seattle, Wash.—The damaged steamer Sagadohoc was placed on drydock at Seattle for hull repairs.

Conversion of Tanker, San Pedro, Cal.—The British tanker Lumina is being converted from a coal to an oil burner.

Steamer Drydocked, Portland, Ore.—The Japanese steamer Yoshida Maru has been drydocked for cleaning and painting.

Vessel Overhauling, Oakland, Cal.—The steamer Bessie M. Hanlon has been placed on the Hanlon ways for an overhauling.

Overhauling Steamer, Portland, Ore.—Steamer Hawaiian, of the American-Hawaiian fleet, has been drydocked for an overhauling.

Minor Repairs, Mobile, Ala.—The steamship Labette was awarded to the Alabama Dry Dock and Shipbuilding Company for minor repairs.

Low Bidder, San Francisco, Cal.—The Crowley Shipyard was low bidder for repairs to the British steamer Berengar, with a tender of $800.

Vessel Drydocked, Portland, Ore.—The Columbia River Packers' Association cannery vessel has been placed on drydock at Portland for repairs.

Tanker Drydocked, San Francisco, Cal.—The Standard Oil tanker W. S. Miller has been placed on the ways of the Bethlehem Shipbuilding Company.

Vessel Overhauled, San Francisco, Cal.—The tanker Mursa was awarded the Bethlehem Shipbuilding Corporation for overhauling, to enter the oil trade.

Extensive Reconditioning, San Francisco, Cal.—The Bethlehem Shipbuilding Corporation received the contract for overhauling the interior of the yacht Edyth.

Repairs to Steamboat, Baltimore, Md.—The Redman & Vane shipyard was awarded the work of docking and repairing the sidewheel steamboat E. Madison Hall.

Overhauling Steamer, Portland, Ore.—The Shaver Transportation Company's steamer No Wonder has been placed on the docks of the Portland Shipbuilding Company.

Miscellaneous Repairs, Philadelphia, Pa.—The steam pilotboat Philadelphia has been taken to the Philadelphia Ship Repair Company's yards for miscellaneous repairs.

Steamer Fitted, Baltimore, Md.—The Shipping Board awarded the fitting of the steamer Deer Lodge to carry cattle to Lewis Waggner & Company, on a bid of $6,700.

Diesel Engines Fitted, Oakland, Cal.—The steamer Maguhkook, of the Oceanic Steamship Company, was awarded to the Moore Drydock Company for the installation of Diesel engines.

Flush Deck Barges, Nashville, Tenn.—U. S. Engineer Office, Nashville, is in the market for the rental of three flush deck barges, steel or wood, from 200 to 300 tons capacity.

General Repairs, San Francisco, Cal.—The schooner Bangon and the steamer Whitney Olson have been placed on the Bethlehem drydocks for cleaning, painting and general repairs.

Miscellaneous Repairs, Mobile, Ala.—The Lighthouse tender Sunflower was awarded to the Alabama Dry Dock and Shipbuilding Company for scraping, painting and other miscellaneous repairs.

Cleaning and Painting, Boston, Mass.—The Nantucket, nautical school ship, has been moved to the Boston Navy Yard for cleaning and painting, prior to departure about May 1 on the annual cruise.

Vessel Repairs, Seattle, Wash.—The steamship Wallingford, recently bought from the Shipping Board by the McCormick Steamship Company, has been shifted to a Seattle drydock for overhauling.

General Repairs, Oakland, Cal.—The Hanlon Drydock and Shipbuilding Company received the contract for general repairs, cleaning and painting of the Hart-Wood Lumber Company's steamer Solano.

Painting, etc., San Francisco, Cal.—The new ferryboat Hayward was taken to the ways of the General Engineering and Drydock Company to be painted, bulwarks removed and to have her engines overhauled.

Vessel Drydocked, Oakland, Cal.—The Hanlon Shipbuilding and Drydock Company was awarded the contract for drydocking, recaulking and other work on the schooner Honolpu, recently purchased by N. H. Hickman.

Vessel Repairs, Sparrows Point, Md.—The Bethlehem Shipbuilding Corporation has been awarded the work of repairing the West Arrow, at a price of $4,196. The same company was awarded the docking of the West Haven.

Seattle Shipyard Activities.—The following repairs were awarded to Seattle shipyards: Steamship Admiral Evans, for reconditioning; steamship H. F. Alexander, to ship new propellers, and steamship Seapora, for overhauling.

Tailshaft, Etc., Philadelphia, Pa.—The William Cramp & Sons Ship and Engine Building Company has completed a contract which consisted of installing a new tailshaft and propeller on the gunboat Bravo, of the Mexican Navy.

Extensive Reconditioning, West Coast. — The freighter Meriden, recently sold by the General Steamship Corporation to the E. K. Wood Lumber Co., is to undergo extensive reconditioning to fit her for the coastwise lumber trade.

Steamboat Converted, Port Blakely, Wash.—The Johnson Shipyard, Port Blakely, has been converting the steamboats City of Angeles and Puget of the Puget Sound Navigation Company into modern ferryboats. Price $30,000 each.

Refitting for Service, Oakland, Cal.—The tank motorship Nuuanu, of the Philippine Vegetable Oil Company, was placed on the ways of the Hanlon Drydock and Shipbuilding Company to undergo an overhauling, preparatory to being placed in service again.

Contract Awarded, San Francisco, Cal.—With a bid of $1,188, the General Engineering and Drydock Company has been awarded the contract for repairs to the California and Oregon Lumber Company's steamer Brookings, formerly the Shipping Board steamer Cowiche.

Contracts Awarded, Seattle, Wash.—The Todd Drydocks were awarded the following contracts: Shipping Board tanker Lubrico, a fishing schooner, a Government-owned brigantine, fisheries steamship, a Puget Sound tugboat, an ocean-going tug, and a lighthouse tender.

Preparation for Service, Sparrows Point, Md.—Previous to being prepared for service, the sidewheel steamer Majestic, bought at Washington by the Annapolis and Claiborne Ferry Company, has been placed in the upper yard of the Bethlehem Shipbuilding Corporation.

Shipyard Activities, Oakland, Cal.—The Moore & Scott shipyard, Oakland, is very busy as a result of having been awarded the following vessels: The ferryboat Cazadero, drydocking; schooner City of Sydney, repairs; two United States submarine chasers, the Vaughn and Cygan, overhauling; and the Lake Cayuga and Lake Francis, conversion to oil and lumber schooners.

Low Bidder for Barge, San Francisco, Cal.—Bethlehem Shipbuilding Corporation, San Francisco, submitted the lowest tender for the construction of a 12,000-barrel towing barge for the Standard Oil Company of California, with a price of $219,775 and four and one-half months.

Voyage Repairs, Oakland, Cal.—At the opening of bids for voyage repairs to the Pacific Mail liner President Taft the Moore Drydock Company was low bidder with $7,264. The other bids were: Bethlehem, $7,840; United Engineering Company, $8,199, and General Engineering, $10,865.

Contracts Awarded, Mobile, Ala.—The Alabama Dry Dock & Shipbuilding Company, Mobile, received the following contracts: Steamship Afoundrias, repairs to engine room, pipe lines, boilers, etc.; tug Jim Sid, cleaning and painting; and tug Major Carl A. Lohr, for miscellaneous repairs.

Carfloat Launched, Sparrows Point, Md.—The first of two huge steel carfloats, under construction for the Baltimore and Ohio Railroad, has been launched from the Sparrows Point plant of the Bethlehem Shipbuilding Corporation. The float is 285 feet long, 37 feet 6 inches beam and 10 feet 6 inches draft.

Miscellaneous Repairs, San Francisco, Cal.—The Bethlehem Shipbuilding Corporation was awarded the following contracts: The Standard Oil tanker Colonel E. L. Drake, general repairs; and the Virginian of the American-Hawaiian intercoastal fleet, overhauling of tail shaft and renewal of propeller blades.

Reconditioning Work, Oakland, Cal.—The Hanlon Shipbuilding Company, Oakland, was awarded a large reconditioning job on the lumber carrier Catherine G. Sudden. The Star of Scotland and the Pacific Mail steamer Corinto have also been placed on the ways of the Hanlon for general overhauling.

Scout Cruiser Launched, Philadelphia, Pa.—The 550-foot scout cruiser Trenton, of 90,000 horsepower, has been launched at the shipyard of William Cramp & Sons. She is the second of five scout cruisers being built at the Cramp shipyard for the United States Navy and is expected to make a speed of thirty-three knots.

General Overhaul, Brooklyn, N. Y.—The contract for the drydocking and general overhauling of the steamship Natirar has been awarded to James Shewan & Sons at a price of $36,810. The proposals submitted were as follows: Shewan, $36,810; Robins, $38,850; Crane, $39,890; Morse, $42,182; Federal, $48,185.

Double Launching, Baltimore, Md.—Charles L. Rohde & Sons Company recently held a double launching of a carfloat for the Atlantic Transport Company, 240 feet long, 34 feet wide and 9 feet 6 inches molded depth, and a lighter for the Southern Railway Company, of Norfolk, 125 feet long, 30 feet wide and 8 feet 6 inches deep.

Vessel Overhauling, Portland, Ore.—The late Rear Admiral Peary's famous vessel, the former Arctic explorer Roosevelt, is being overhauled to go in service as a towing vessel. The most modern towing apparatus obtainable is being installed on board the Roosevelt, which is to be utilized in the towing of lumber barges between Puget Sound and California.

Fire Damage, Panama City.—The coastwise steamer Tarpon, operated by the Pensacola, St. Andrews and Gulf Steamship Company, between Pensacola and Mobile and Carabelle was badly damaged by fire on March 23. She was moored at Panama City docks and damage was covered by insurance, it is said. The Tarpon has been in service more than twenty years.

Conversion to Passenger Steamer, Baltimore, Md.—The Baltimore and Carolina Steamship Company

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has announced that the Mary Weems, now being used on the freight run of the line, will be put in the Baltimore shipyards shortly for the beginning of work which will make her a passenger ship, to accommodate 200 first class passengers and 50 second class. J. L. Doten, Charleston, S. C., representative.

Shipyard Activities, San Francisco, Cal.—The Bethlehem Shipbuilding Corporation has been awarded the following contracts: Work of retubing condensers, feed water heaters, and rebuilding anchor windlass on the Compagnie Du Boleo's steamer Providencia; reconditioning Associated Oil Company's tug Arabs, price $21,795; and the C. A. Smith, lumber carrier, for cleaning, painting and overhauling.

Various Contracts, Baltimore, Md.—The Charles L. Rohde & Sons Company received the following contracts: Tugs Wilcox, of Toledo, Ohio, Mary C. McNally and Annie, for overhauling; and barge John J. McNally, for similar work. The German steamer Hessen was floated after replacing a broken propeller blade and having her hull painted. The Vittorio Emmanuele III. has been placed on the lower dock of the company.

Contract Awarded, Oakland, Cal.—The Army Transport Service has awarded the contract for reconditioning of the transport Grant to the Moore Drydock Company, as low bidder, the work consisting of painting and fixing first cabin quarters and installation of accommodations for twenty-four passengers in the second class quarters of the vessel. The Grant has been at the Moore ways for cleaning, drydocking and painting, on a former bid.

Repair Job, Brooklyn, N. Y.—The Robins Drydock & Repair Company, of the Todd Shipyards Corporation, Brooklyn, N. Y., was awarded the contract for repairing the American-Hawaiian freighter Texan, which sustained heavy bottom damage as the result of grounding on Block Island. The bids received were as follows: Robins, $96,790; Morse, $144,496; Shewan, $159,000; Bethlehem, $172,600; Newport News, $181,300; Sun Shipbuilding, $199,615.

Diesel Yacht Construction, Seattle, Wash.—The Blanchard Boat Company is constructing, in the plant of the Tregoning Manufacturing Company on Salmon Bay, the full Diesel- powered yacht Samona, which will be the most palatial craft of her type on the Pacific. The yacht, which is building for W. J. Hole, capitalist and sportsman of Arlington, Cal., will be a triple-screw yacht, each screw being driven by a 100-horsepower, six-cylinder Diesel engine, maintaining a speed of 13 knots. The vessel will be 115 feet long and 18 feet beam, heated by electricity and having all latest improvements.

Tank Steamer Repairs, Brooklyn, N. Y.—At the opening of tenders for extensive repairs to the 6,666 gross ton tank steamship Pennsylvania, of the Texas Oil Company, the Robins Drydock & Repair Company, of the Todd Shipyards Corporation, Brooklyn, N. Y., was successful bidder with a price of $167,000. The Pennsylvania recently went ashore on the Nicaraguan coast and sustained considerable bottom damage, after which she was drydocked at Mobile for survey. The following are the proposals received: Robins, $167,000; Newport News, $175,000 Morse, $176,000; Alabama, $179,488; Jahncke, $263,000.

Reconditioning Work, West Coast.—The Moore Drydock Company was low bidder for work of drydocking, cleaning and painting the Pacific Mail steamer Point Bonita, chartered by the E. K. Wood Lumber Company. The tenders were as follows: Moore's, $1,299; Bethlehem, $1,525, and Hanlon's, $1,919. Bids opened for repairs to the United States Army transport Grant were: Moore's, $6,798; Bethlehem, $6,996; for cleaning, drydocking and painting. The Moore Company was also low bidder for engine and boiler repairs to the transport Grant, with a price of $9,878, against the Bethlehem Shipbuilding Company's tender of $9,954.

Towboat Hull, Jeffersonville, Ind.—The Howard Shipyards & Dry Dock Company, of Jeffersonville, Ind., with a price of $19,737, was low bidder for the construction of a steel hull for the towboat Elinor, at the opening of tenders by the United States Engineer Office, Rock Island, Ill., on April 12. The boat is to be of the sternwheel type, having a molded length of 125 feet 4 inches, molded breadth 27 feet, constructed with five transverse watertight bulkheads. The bids were: Howard Shipyards & Dry Dock Company, $19,737; Dubuque Boat & Boiler Works, $20,000; Dravo Contracting Company, $25,600; Nashville Bridge Company, $25,900; Charles Ward Engineering Works, $27,200.

Contracts Awarded, Mobile, Ala.—The Alabama Dry Dock and Shipbuilding Company has been awarded the following contracts: Shipping Board steamship Hugoton, cleaning, painting, general overhauling of machinery, etc.; Mississippi-Warrior Service Towing steamer Demopolis, repairs to propellers, renewing rudders, machinery job and several other miscellaneous repairs; steamship Shreveport, overhauling machinery, caulking decks, scraping, painting, etc.; steamship Halway, miscellaneous repairs; steamship Tuxpanoil, repairs; tug Hulver, extensive repairs; steamship Bayou Chico, repairs; schooner Maid of Scotland, cleaning, painting and examination, and oil tanker San Leonardo, of the Eagle Oil Transport Company, Ltd., for examination.

SHIPYARDS AND DRYDOCKS

Dismantling Yard, Baltimore, Md.—The Atlantic Wrecking Company, of which Victor M. Jarrett is president and general manager, will establish modern facilities for dismantling ships at Baltimore on the waterfront of Curtis Bay. About $60,000 will be expended to clear the site of old grain elevator buildings purchased from the Baltimore & Ohio Railroad, after which the wrecking facilities will be installed, the capacity to be four steamships at one time.

Shipyard, Lower California.—According to Bartley F. Yost, American Consulate at Guaymas, Sonora, Mexico, American interests have asked permission from the Secretary of Communications to install at Santa Rosalia, Lower California, a shipyard for constructing vessels up to 5,000 tons, destined for coastwise and high seas traffic. The company is requesting certain franchises, and states that as soon as the vessels are completed it intends to use them for its own account in open competition with foreign steamship companies.

PORT IMPROVEMENTS

Harbor Improvements, Monterey, Cal.—City plans election to vote on $200,000 bonds for harbor improvements, dredging, fill, etc.

Piling, Brokaw, Wis.—L. A. De Guere, engineer, Wisconsin Rapids, is taking bids for 800 tons Lackawanna steel piling, for Wausau Paper Company.

Grain Elevator, Oswego, N. Y.—An appropriation of $1,307,000 has been made for the completion of the grain elevator and terminal on the State Barge Canal at Oswego.

Grain Elevator, Goderich, Ont.—Western Canada Flour Mills, 293 McPherson avenue, Toronto, plans 750,000-bushel addition to grain elevator, reinforced concrete. $250,000.

Canal, Etc., New London, Wis.—City Council has appropriated $750,000 to construct canal and drainage system to join Wolf and Embarrass Rivers. C. J. Thompson, clerk.

Dredging, North Carolina.—State Fish Commission, Raleigh, plans to dredge and deepen various inlets to sounds in North Carolina. $500,000. J. K. Dixon, Trenton, chairman of Commission.

Pier, San Diego, Cal.—The city voted $495,500 bonds for completion of municipal pier No. 2, including apron wharf, transit shed, paving trackage and equipment. F. A. Rhodes, city engineer.

Harbor Facilities, Troy, N. Y.—Harbor & Dock Commission, Troy, has $1,250,000 available for harbor facilities. Plans municipal terminal, $350,000. M. L. Murray, 16 First street, president.

Dredging, Buffalo, N. Y.—The Empire Engineering Company, Inc., North Tonawanda, received the contract for dredging Buffalo Inner Harbor to completed contract depth for maintenance of channel, at a price of $0.345 per cubic yard.

Levees, Monroe, La.—G. B. Lambert Company awarded the contract for 1,000,000 cubic yards of levee work on Mississippi River, near Monroe, to W. E. Callahan Construction Company, Great Southern Life Building, Dallas, Tex. $250,000.

Canal to Be Opened, New Orleans, La.—The new Inner Harbor Navigation Canal will be opened formally at the close of the annual convention of the National Foreign Trade Council in New Orleans, May 2 to 4. This canal connects the Mississippi River with Lake Ponchartrain and transforms great tracts of interior lands into waterfront property suitable for purposes of commerce and industry.

City Wharf, Norwalk, Conn.—Sealed proposals were received by John H. McMahon, chairman, City Hall, Norwalk, Conn., for alternate bids for the construction of about 200 lineal feet of concrete and creosoted lumber wharf with appurtenances, on April 2.

Grain Elevator, Goderich, Ont.—Goderich Grain Elevator & Transit Company is having plans prepared for a reinforced-concrete grain elevator, 1,000,000 bushel capacity, on harbor. Price, $250,000. J. H. Tromanhauser, 69 Adelaide street, East, Toronto, engineer.

Miscellaneous Supplies, Memphis, Tenn.—Sealed proposals were received by the Mississippi River Commission, First and Second Districts, Custom House, Memphis, on April 23, for furnishing and delivering steel bars, wire fencing, machine bolts and insulating paper.

Concrete Wharf, Etc., New Orleans, La.—Sealed proposals were received by the Board of Commissioners of the Port of New Orleans, Suite 200, New Court Building, on April 5, for concrete wharf, chain walls and column footings for shed at Claiborne Avenue Landing.

Canal, Lakeland, Fla.—Lake Parker D. D., canal between Lake Parker and Lake Boney. S. T. Buchannan & Son, Lakeland, received the contract for 50,000 cubic yards of earth and 40,000 cubic yards of rock excavation, 200 cubic yards reinforced-concrete. Price $0.33⅓ earth and rock.

Flood Gate, Etc., Blytheville, Ark.—Poinsette Company will soon take bids for flood gate and navigation lock, $200,000, and also plans complete flood protection and river control system, ultimate cost, $5,000,000. Pride & Fairley, Blytheville, engineers.

Piling, New Orleans, La.—Sealed proposals were received by the Board of Commissioners of the Port of New Orleans, Suite 200, New Court Building, on April 26, for furnishing 7,500 pieces of green piling in 50 and 75-foot lengths, according to Dock Board specifications. Requisition ED-13352.

Contract Awarded, Houston, Tex.—Anderson Clayton & Company, Mason Building, has awarded the following work to J. B. Townsend, Houston, at a price of $750,000: warehouses, reinforced-concrete woodpile foundations, cotton compress, 600-foot wharves, concrete construction, also dredging channel.

Bulkhead, Etc., Chicago, Ill.—The Great Lakes Dredge & Dock Company, 104 South Michigan avenue, was awarded the contract by South Park Commissioners, 57th street and Cottage Grove avenue, for bulkhead from 12th to 20th streets, $1,164,310; 1,000 foot extension to bulkhead at 23rd street, $95,000.

Contract Awarded, Baltimore, Md.—The contract for the construction of the four million bushel grain elevator to be built for the Baltimore & Ohio Railroad at Locust Point, to replace its two elevators destroyed by fire there last July, has been awarded to M. A. Long Construction Company, of Baltimore. Price, $3,000,000.

Dredging Contract, Mays Landing, N. J.—The Commerce & Navigation Department, State House, Trenton, awarded the contract for dredging 57,142 square yards of main channel, Absecon Inlet, Mays Landing, to Hill Dredging Company, Atlantic and Somerset streets, Atlantic City. Price, $0.35 per square yard. Total price, $19,999.70.

Levees, Yuba City, Cal.—Reclamation District 1660, State Reclamation Board, Forum Building, Sacramento, Cal., awarded the contract for 13-mile levees, varying 12 to 22 feet in height, 2,600,666 cubic yards of clamshell work, and 1,110,000 cubic yards of long boom dredger work, Yuba City, to Callahan Construction Company, City National Bank, Wichita Falls, Tex. Price, $915,000.

Grain Elevator, Baltimore, Md.—Bids will be received by the Baltimore & Ohio Railroad, Baltimore and Charles streets, Baltimore, for grain loading pier, merchandise pier, storage bins, steel and reinforced concrete, 3,000,000 to 4,000,000 bushel capacity, Locust Point. Price, $3,500,000. J. S. Metcalfe, 108 South La Salle street, Chicago, architects. L. P. Kimball, Engineering Building, of Baltimore & Ohio Railroad, engineer.

Contract Awarded, Ft. Worth, Tex.—The Western Engineering Company, Dallas County State Bank Building, Dallas, was awarded the contract by Ft.

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Worth Elevators Company, N. P. Anderson Building, for one 750,000 bushel elevator and storage tank, 54 by 72 by 192 feet head house with thirty-six 23 by 100 feet storage tanks, all concrete, four 2,500 bushel straight hopper scales, six main elevator legs with 30-inch lift belts, two receiving legs, two shipping legs, one serving leg, and one transfer leg, two large Carter disc separators, one 1,500-bushel hour capacity clipper and scourer, two Richardson auto sacking machines and scales. Price, $1,000,000.

GOVERNMENT WORK

Scows, Wilmington, Del.—U. S. Engineer, Wilmington, plans to purchase two wooden dump scows.

Repairing Jetty, Galveston, Tex.—U. S. Engineer plans to repair building and extend jetty at Sabine.

Superstructure, Dunkirk, N. Y.—U. S. Engineer plans stone superstructure on breakwater at Dunkirk.

Dredging, Galveston, Tex.—U. S. Engineer plans dredging Houston Ship Channel at Vinces Bayou and Basin.

Dredging, Washington, D. C.—U. S. Engineer, 250 Old Land Office Building, plans dredging in Potomac River.

Gate Tracks, Huntington, W. Va.—Gate tracks at Dam 13, Ohio River, are planned by U. S. Engineer, Huntington.

Barges, Jacksonville, Fla.—U. S. Engineer, Jacksonville, plans to purchase three steel barges for dredge Mallery, Ohio River.

Dredging Pump, Jacksonville, Fla.—Bids were received by U. S. Engineer, Jacksonville, up to April 20, for a dredging pump.

Dredging, Claiborne Harbor, Md.—U. S. Engineer Office, Baltimore, received sealed proposals on April 30, for dredging in Claiborne Harbor, Md.

Dredging Bids Rejected, New York, N. Y.—U. S. Engineer, 616 Army Building, has rejected bids opened on March 2, for dredging in Shrewsbury River, N. J.

Boilers, Florence, Ala.—Bids were received on April 27, at the office of the U. S. Engineer, Florence, for installing steam boilers, etc., on the U. S. Towboat General John Coffee.

Steel Gates, Nashville, Tenn.—Sealed proposals were received by U. S. Engineer Office, Nashville, on April 25, for steel gates for Lock 8, Cumberland River. Further information on application.

Dredging, Wharves, Etc., Pearl Harbor, H. T.—Specifications 4798—Bureau of Yards and Docks, Navy Department, Washington, D. C., plans dredging, wharfs and piers at submarine base. Bids opened at local yard.

Fuel Oil, Philadelphia, Pa.—U. S. Engineer, 815 Witherspoon Building, awarded the contract for furnishing 40,000 barrels of fuel oil for vessels in Philadelphia, to Crew Levick Company, 111 North Broad street. $73,750.

Rock Removal, Etc., New York, N. Y.—U. S. Engineer, Army Building, 39 Whitehall street, awarded Arundel Corporation, 2 Pratt street, Baltimore, Md., the contract for dredging and rock removal in East River. $704,387.

Painting, Etc., Vessel, Staten Island, N. Y.—Sealed proposals were received by the Superintendent of Lighthouses, Third District, Staten Island, N. Y., on April 2, for docking, cleaning and painting Relief Light Vessel No. 78.

Drydocking, Etc., Staten Island, N. Y.—Sealed proposals were received at the office of Superintendent of Lighthouses, Third District, Staten Island, N. Y., on April 2, for drydocking, cleaning and painting U. S. Lighthouse Barge No. 2.

Cylinder Valves, Etc., Florence, Ala.—U. S. Engineer Office, Florence, received sealed proposals on April 20 for furnishing and delivering six sets of cylinder valves, operating mechanism for the same, etc., for the navigation lock of Wilson Dam.

Superstructure, Detroit, Mich.—Sealed proposals will be received by U. S. Engineer Office, Detroit, Mich., until 11 A. M., Eastern Standard Time, May 3, 1923, for construction of concrete superstructure on west center pier, St. Mary's Falls Canal. Further information on application.

NEW INCORPORATIONS

The Submarine Signal Corporation, capital $9,000,000, chartered in Delaware.

The Montrose Steamship Corporation of New York, capital $250,000, chartered under Delaware laws.

The American Export Corporation, of Manhattan, has increased its capitalization from $25,000 to $100,000.

The Niagara Ferry & Transportation Company has increased its capitalization from $25,000 to $300,000.

William Grixcom Coxe, capital $500,000, incorporated under Delaware laws, to do business as ship brokers.

The Hammond Steamship Company, of Wilmington, Del., capital $1,000,000, to do business as builders, chartered under Delaware laws.

Ralph Steamship Company, of Brooklyn, capital $100,000, chartered at Albany. Incorporators: L. N. and J. A. Martin and P. J. Dobson.

The Transit Forwarding Company of Buffalo, capital $20,000, chartered at Albany. Incorporators: E. B. and A. B. Black and D. L. Sprissler.

U. S. & Levant Steam Navigation Company, capital $250,000, chartered at Albany. Incorporators: J. J. Binder, S. Brander and R. Frackman.

The Palestine & Oriental Steamship Corporation of Manhattan, capital $20,000, chartered at Albany. Incorporators: E. Rosen and J. & A. Haber.

Rotary Navigation and Transportation Company of Manhattan, capital $50,000, chartered at Albany. Incorporators: M. M. Miller and J. W. Bagley.

United States & China Steamship Co., Inc., capital $12,000,000, to operate between New York and Far East ports. David L. Baumgarten, president.

The Olympus Steamship Corporation, of Manhattan, capital $10,000, chartered at Albany. Incorporators: W. S. Auld, J. J. Binder and S. Brander.

T. A. Kyle Company, of the Bronx, shipyard, capital $50,000, incorporated under New York laws. Incorporators: T. A. and J. Kyle, and G. L. Bergen.

The Florence B. Phillips Shipping Corporation of Manhattan, capital $50,000, incorporated at Albany, to do general lighterage business. Incorporators: J. Potts, E. C. Bould, and G. Palmer.

Russian-American Volunteer Fleet, capital $10,000, chartered under Delaware laws to operate boats. Incorporators: E. C. Barton of Yonkers, and Martha Kobloff and Ralph F. Kane.

Warner Transport and Trading Company; principal place of business, Miami; capital stock, $20,000; limit of indebtedness, $1,000,000. General nature of business, the transportation for hire of passengers and of all kinds of goods between ports in the United States and of the world by means of steam, sailing or other vessels. E. M. Kenworthy, president; E. B. Kurtz, vice-president; W. L. Reed, second vice, and W. T. Schutt, secretary.

MARINE SOCIETIES

AMERICA

American Society of Naval Engineers
Navy Department, Washington, D. C.
Secretary-Treasurer—Commander S. M. Robinson, U. S. N., Bureau of Engineering, Navy Department, Washington, D. C.

Society of Naval Architects and Marine Engineers
29 West 39th Street, New York.
Secretary and Treasurer—Daniel H. Cox.

National Asociation of Engine and Boat Manufacturers
29 West 39th Street, New York City.
Secretary—R. R. A. Hand.

United States Naval Institute
Naval Academy, Annapolis, Md.
Secretary and Treasurer—Commander H. K. Hewitt, U. S. N.

American Marine Association
15 Park Row, New York
President—E. A. Simmons.
Secretary—Robert B. Lea.

The New York Tow Boat Exchange
11 Moore St., New York.
Secretary—Irving G. Keller.

Port of New York Authority
11 Broadway, New York.
Chairman—E. H. Outerbridge.
Secretary—William Leary.

Marine Engineers' Supply Men's Association
Room 507, 30 Church Street, New York.
Secretary—Robert P. Jones.

National Association of Masters, Mates and Pilots
National Secretary—M. D. Tenniswood, 308 Vine St., Camden, N. J.

American Society of Marine Designers
Secretary—B. G. Barnes, 202 Kendrick Ave., Quincy, Mass

National Marine Engineers' Beneficial Association
Headquarters 311-315 Machinists Building, Washington, D. C.
Secretary-Treasurer—George A. Grubb.

Atlantic Coast Shipbuilders' Association
1701 Walnut Street, Philadelphia, Pa.
Secretary—C. S. King.

American Steamship Owners' Association
11 Broadway, New York
President—A. G. Smith.
Vice-President and General Manager—Winthrop L. Marvin.

United States Ship Operators' Association
149 Broadway, New York
President—C. H. Potter

National Merchant Marine Association
Munsey Bldg., Washington, D. C.
President—Hon. J. E. Ransdell.

The Maritime Association of the Port of New York
78 Broad St., New York City
President—Charles H. Potter.
Secretary—Walter F. Firth.

Lake Carriers' Association
Detroit, Mich.
Secretary—George A. Marr.

Neptune Association
21 Pearl St., New York City
Secretary-Treasurer—Captain John F. Milliken.

Ocean Association of Marine Engineers
15 Whitehall St., New York City
Secretary—Bert L. Todd.

CANADA

Grand Council N. A. of M. E. of Canada
Grand Secretary-Treasurer—Neil J. Morrison, Box 886, St. John, N. B.

GREAT BRITAIN

Institution of Naval Architects
5 Adelphi Terrace, London, W. C.

Institution of Engineers and Shipbuilders in Scotland
39 Elmbank Crescent, Glasgow.

Northeast Coast Institution of Engineers and Shipbuilders
Bolbec Hall, Westgate Road, Newcastle-on-Tyne.

Institute of Marine Engineers, Incorporated
The Minories, Tower Hill, London.

ITALY

Collegio Degli Ingegneri Naval e Meccanici in Italia

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